

07.73
2496842



ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XXX

1943-1947

PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE
PITTSBURGH, PENNSYLVANIA
NOVEMBER, 1947

ARRANGED FOR PUBLICATION BY
ARTHUR W. HENN

TABLE OF CONTENTS

Title Page..	i
Table of Contents.....	iii
List of genera and species new to science.....	v

ARTICLE

I. Studies in the Jacamars and Puff-birds. By W. E. C. Todd (Issued Oct. 20, 1943).....	1-18
II. Some large straight Ordovician Cephalopods from Minnesota, pls. I-IV. By A. K. Miller and Bernhard Kummel (March 13, 1944).....	19-38
III. South American Aradidae (Hemiptera) in the Carnegie Museum. By C. J. Drake and H. M. Harris (March 13, 1944).	39-44
IV. Affinities of <i>Phoebis rorata comstocki</i> , a new pierid butterfly from Jamaica, pls. I-III. By A. Avinoff (May 11, 1944).....	45-56
V. A new terrestrial vulture from the Upper Eocene Deposits of Wyoming, pls. I-V. By Alexander Wetmore (May 24, 1944).....	57-70
VI. Another new boa of the genus <i>Epicrates</i> from the Bahamas. By M. Graham Netting and Colman J. Goin (May 24, 1944).....	71-76
VII. <i>Brachyuranochampsia eversolei</i> , gen. et sp. nov., a new Crocodilian from the Washakie Eocene of Wyoming, pls. I-III. By Rainer Zangerl (Oct. 18, 1944).....	77-84
VIII. The spineless soft-shelled turtle, <i>Amyda mutica</i> (Le Sueur), in Pennsylvania. By M. Graham Netting (Oct. 18, 1944).	85-88
IX. Additions to the list of Mexican amphibians and reptiles in the Carnegie Museum. By Hobart M. Smith (Nov. 2, 1944).....	89-92

X.	A second specimen of an African bat, <i>Plerotes anchietae</i> (Seabra). By Glover M. Allen (May 10, 1945) . . .	93-96
XI.	The birth of habitat bird groups, pls. I-XI. By Frederic S. Webster (Sept. 10, 1945).....	97-118
XII.	Scolecodonts from the Trenton Series (Ordovician) of Ontario, Quebec, and New York, pls. I-VII. By E. R. Eller (Oct. 1, 1945).....	119-212
XIII.	A review of the Boletes (Fungi) of western Pennsylvania, pls. I-III. By LeRoy K. Henry (Jan. 10, 1946).....	213-240
XIV.	Larval development of the Eastern Narrow-Mouthed Frog, <i>Microhyla carolinensis</i> (Holbrook), in Louisiana, 1 pl. By Grace L. Orton (Feb. 8, 1946).. . . .	241-248
XV.	A distributional study of the Pine Siskin. By Dorothy Mierow (Feb. 25, 1946).....	249-262
XVI.	An annotated list of the butterflies of Jamaica, 1 pl. By A. Avinoff and N. Shoumatoff (Dec. 13, 1946).....	263-296
XVII.	Critical notes on the woodpeckers. By W. E. C. Todd (Dec. 16, 1946).....	297-318
XVIII.	The Cephalopod fauna of the Conemaugh Series in western Pennsylvania: Supplement, pls. I-II. By A. K. Miller and A. G. Unklesbay (March 14, 1947) . .	319-330
XIX.	New South American parrots. By W. E. C. Todd (April 14, 1947).....	331-338
XX.	A review of the Gasteromycetes (Fungi) of western Pennsylvania, pls. I-IV. By L. K. Henry (June 11, 1947).....	339-362
XXI.	Notes on some hyloid tadpoles in Louisiana, pls. I-II. By Grace L. Orton (Oct. 22, 1947).....	363-382
XXII.	Notes on the birds of southern Saskatchewan. By W. E. C. Todd (Oct. 23, 1947).....	383-421
	Index.....	423-438

LIST OF GENERA AND SPECIES NEW TO SCIENCE

<i>Jacamerops aurea ridgwayi</i> , subsp. nov.	Aves.....	2
<i>Urogalba dea brunneiceps</i> , subsp. nov.	"	6
<i>Urogalba dea phainopepla</i> , subsp. nov.	"	6
<i>Galbula tombacea mentalis</i> , subsp. nov.	"	9
<i>Brachygalba phæonota</i> , sp. nov.	"	10
<i>Nystactes tamatia punctuliger</i> , subsp. nov.	"	14
<i>Nystactes tamatia inexpectatus</i> , subsp. nov.	"	14
<i>Malacoptila panamensis magdalenæ</i> , subsp. nov.	"	15
<i>Endoceras clarkei</i> , sp. nov.	Cephalopoda.....	24
<i>Endoceras gracillimum</i> , sp. nov.	"	27
<i>Endoceras decorahense</i> , sp. nov.	"	27
<i>Notoplocoris potensis</i> , sp. nov.	Hemiptera.....	43
<i>Phoebis rorata comstocki</i> , subsp. nov.	Lepidoptera.....	49
<i>Eocathartes</i> , gen. nov.	Aves.....	58
<i>Eocathartes grallator</i> , sp. nov.	"	58
<i>Epicrates excul</i> , sp. nov.	Reptilia.....	71
<i>Brachyuranochampsia</i> , gen. nov.	"	77
<i>Brachyuranochampsia eversolei</i> , sp. nov.	"	77
<i>Lumbriconereites linki</i> , sp. nov.	Annelida.....	127
" <i>concertatorius</i> , sp. nov.	"	127
" <i>curvus</i> , sp. nov.	"	128
" <i>projectus</i> , sp. nov.	"	129
" <i>crassus</i> , sp. nov.	"	129
" <i>langae</i> , sp. nov.	"	130
" <i>jenningsi</i> , sp. nov.	"	131
" <i>irregularis</i> , sp. nov.	"	131
" <i>macmillani</i> , sp. nov.	"	132
" <i>johnsoni</i> , sp. nov.	"	132
" <i>triquetrus</i> , sp. nov.	"	133
" <i>bicornis</i> , sp. nov.	"	134
" <i>longae</i> , sp. nov.	"	134
" <i>tuberosus</i> , sp. nov.	"	135
" <i>kosinskii</i> , sp. nov.	"	136
" <i>dissimilis</i> , sp. nov.	"	136
" <i>angustifossus</i> , sp. nov.	"	137

Lumbriconereites okulitchi , sp. nov.	"	138
" assimilis , sp. nov.	"	138
Arabellites claytonae , sp. nov.	"	140
" doutti , sp. nov.	"	141
Ildraites camurus , sp. nov.	"	142
" fuehreri , sp. nov.	"	142
" rarus , sp. nov.	"	143
Leodicites brooksi , sp. nov.	"	144
" biformis , sp. nov.	"	144
" artus , sp. nov.	"	145
" semiquadratus , sp. nov.	"	146
" antefixus , sp. nov.	"	146
" continuus , sp. nov.	"	147
" collatatus , sp. nov.	"	147
" exilis , sp. nov.	"	148
" arquatus , sp. nov.	"	148
" agostini , sp. nov.	"	149
" anticus , sp. nov.	"	149
" absolutus , sp. nov.	"	150
" angustisulcus , sp. nov.	"	151
" breviculus , sp. nov.	"	151
" clementi , sp. nov.	"	152
" buris , sp. nov.	"	152
" bisulcus , sp. nov.	"	153
" angulus , sp. nov.	"	154
" convallis , sp. nov.	"	154
" corbis , sp. nov.	"	155
Staurocephalites appositus , sp. nov.	"	156
" kayi , sp. nov.	"	156
" aduncus , sp. nov.	"	157
" arcus , sp. nov.	"	157
" admirabilis , sp. nov.	"	158
" absimilis , sp. nov.	"	159
" bijugus , sp. nov.	"	159
" cuneiformis , sp. nov.	"	159
" absis , sp. nov.	"	160
" tripplus , sp. nov.	"	160
" agriodos , sp. nov.	"	161
" nettingi , sp. nov.	"	162

Staurocephalites	mierowae , sp. nov.	"	162
"	heppenstallae , sp. nov.	"	163
"	paquettensis , sp. nov.	"	164
"	mccallae , sp. nov.	"	164
Ænonites	adversus , sp. nov.	"	165
"	intrinsecus , sp. nov.	"	165
"	fissilis , sp. nov.	"	166
"	dubius , sp. nov.	"	166
"	bittingsae , sp. nov.	"	167
"	coggeshalli , sp. nov.	"	168
"	impardentatus , sp. nov.	"	168
"	bidwelli , sp. nov.	"	169
Paleœnonites	acutus , sp. nov.	"	170
"	dillae , sp. nov.	"	170
"	castigatus , sp. nov.	"	171
"	henryi , sp. nov.	"	172
"	pennatus , sp. nov.	"	173
"	clinatus , sp. nov.	"	173
"	frickei , sp. nov.	"	174
"	comptus , sp. nov.	"	175
"	davisae , sp. nov.	"	175
"	circumscriptus , sp. nov.	"	176
Eunicites	tolmachoffi , sp. nov.	"	177
"	geisacanthus , sp. nov.	"	178
"	whiteae , sp. nov.	"	178
"	compressus , sp. nov.	"	179
"	barbaricus , sp. nov.	"	179
"	toddi , sp. nov.	"	180
"	sweadneri , sp. nov.	"	180
"	kirkfieldensis , sp. nov.	"	181
"	twomeyi , sp. nov.	"	181
"	acus , sp. nov.	"	182
"	colossus , sp. nov.	"	182
"	acis , sp. nov.	"	183
"	aculeus , sp. nov.	"	183
"	conjectus , sp. nov.	"	183
"	planoconvexus , sp. nov.	"	184
"	plackae , sp. nov.	"	184
"	cavus , sp. nov.	"	185

<i>Eunicites ansatus</i> , sp. nov.	"	185
<i>Ungulites longidentatus</i> , sp. nov.	"	186
" <i>sumnerae</i> , sp. nov.	"	186
" <i>bifurcus</i> , sp. nov.	"	187
" <i>confertus</i> , sp. nov.	"	187
<i>Nereidavus avinoffi</i> , sp. nov.	"	188
" <i>artatus</i> , sp. nov.	"	188
" <i>alatus</i> , sp. nov.	"	189
" <i>angulosus</i> , sp. nov.	"	190
<i>Marleneites</i> , gen. nov.	"	191
" <i>millerae</i> , sp. nov.	"	192
" <i>arduus</i> , sp. nov.	"	192
" <i>aureus</i> , sp. nov.	"	193
" <i>farrari</i> , sp. nov.	"	193
<i>Marphysaites</i> gen. nov.	"	194
" <i>aptus</i> , sp. nov.	"	194
<i>Orthopelta femoralis</i> , sp. nov.	"	195
" <i>bifidus</i> , sp. nov.	"	196
<i>Siluropelta calcaratus</i> , sp. nov.	"	196
<i>Diopatraites tricuspis</i> , sp. nov.	"	197
<i>Lerodea tripuncta sinepunctis</i> , ab. nov. Lepidoptera.....		293
<i>Centurus aurifrons incanescens</i> , subsp. nov. Aves.....		298
<i>Chrysoptilus punctigula rubidipectus</i> , subsp. nov. Aves.....		303
<i>Veniliornis passerinus saturatus</i> , subsp. nov. Aves.....		310
<i>Picumnus aurifrons purusianus</i> , subsp. nov. Aves.....		317
<i>Coelogasteroceras dubium</i> , sp. nov. Cephalopoda.....		320
<i>Stenopoceras smithi</i> , sp. nov.	"	323
<i>Bactrites collinsi</i> , sp. nov.	"	324
<i>Pyrrhura molinæ sordida</i> , subsp. nov.	Aves.....	332
<i>Pyrrhura molinæ restricta</i> , subsp. nov.	"	333
<i>Pyrrhura picta orinocensis</i> , subsp. nov.	"	334
<i>Pyrrhura picta microtera</i> , subsp. nov.	"	335
<i>Pyrrhura subandina cæruleiceps</i> , subsp. nov.	"	337
<i>Pionus sordidus antelius</i> subsp. nov.	"	338

707,73
P4PG842



ART. I. STUDIES IN THE JACAMARS AND PUFF-BIRDS

By W. E. CLYDE TODD

INTRODUCTION

A recent study of the Jacamars and Puff-birds in the collection of the Carnegie Museum shows that we have 787 specimens of the former group, representing 28 species and subspecies. Of the latter group there are 854 specimens, and 54 species and subspecies. Of the genera in the two families only *Jacamaralcyon* and *Hapaloptila* are wanting.

Certain species are in such large series that for the first time it has been possible to work out their geographical variants. In the present paper the taxonomy of these species is discussed, new locality-records and extensions of range are noted, and no less than eight forms which appear to be new are described and named. In specifying names of colors free use has been made of Ridgway's "Color Standards and Color Nomenclature." Measurements are in millimeters, and the length of the bill is that of the exposed culmen, except where otherwise stated.

THE RACES OF JACAMEROPS AUREA (MÜLLER).

The Giant Jacamar ranges in the Tropical Zone from Costa Rica south to Ecuador and the Amazon Valley in Brazil. Until 1922 no geographical variants were recognized, although Ridgway (Bulletin U. S. National Museum No. 50, part 6, 1914, 363) had remarked the peculiarities shown by specimens from certain regions. His series was much too small to justify the recognition of any subspecies, but some years later Bangs and Barbour ventured to discriminate the Central American bird under the name *penardi*. With an exceptionally fine series at my command, I can make out no less than four races of this species, one of which appears to be unnamed. The nominate race comes from Guiana. There prove to be two races in the Amazon Valley, and another in Central America and Colombia (west of the Andes). The characters upon which these several races rest are not absolutely stable, but they are perfectly obvious when series are compared, and sufficiently constant to permit the recognition of the races in question.

***Jacamerops aurea aurea* (Müller).**

Five specimens: Tamanoir and Pied Saut, French Guiana.

Ridgway (*l.c.*) refers to the blue crowns of his Guiana specimens, and this condition is a conspicuous feature in our specimens also. The upper-parts have more bronzy sheen than in *penardi*, and altogether the two respective races seem sufficiently well characterized—at least to be recognizable in series. The blue sheen of the crown extends to the throat as well. The distinctive characters are obvious in both sexes.

The species was originally described from Berbice, British Guiana, and I take our French Guiana specimens to represent it correctly. I have seen no specimens from Venezuela; Ridgway says that those he examined had little or no blue on the forehead.

***Jacamerops aurea ridgwayi*, subsp. nov.**

Twenty-nine specimens: Colonia do Mojuy, Villa Braga, Itaituba, Miritituba, Benevides, and Obidos, Brazil.

Type, No. 77,513, Collection Carnegie Museum, adult male; Miritituba, Rio Tapajóz, Brazil, March 19, 1920; Samuel M. Klages.

Subspecific characters.—Similar to *Jacamerops aurea aurea*, but upper-parts more extensively and more deeply purplish, and crown and throat more greenish, with less blue sheen.

Range.—The lower Amazon basin, west (on the north bank) to the Rio Negro and (on the south bank) to the Rio Tapajóz (and probably to the Rio Madeira).

Measurements (ten males).—Wing, 113-117 (average, 115); tail, 130-140 (135), bill, 49-54 (51.5).

Remarks.—Specimens from Obidos have somewhat bluer crowns, and thus tend toward true *aurea*. I take pleasure in naming this form in honor of Robert Ridgway, who led the way in the study of this species. While the form is clearly entitled to recognition, a search of the literature shows no name certainly applicable to it. Sclater (Monograph Jacamars and Puff-birds, 1879, 59) claims that the specimens of this species known to the older authors all came from the Guianas. Audebert and Vieillot (Oiseaux Dores, 1, Histoire Naturelle . . . Jacamars, etc., 1802, 8, pl. 6) state that the bird is called "Jacamaciri" by the Brazilians, but there is no evidence, in my opinion, that they were describing Brazilian specimens. The *Galbula jacamaciri* of Shaw (Naturalist's Miscellany, 20, 1819, pl. 833) was based in part on their figure.

***Jacamerops aurea isidori* Deville.**

Twenty-five specimens: Hyutanahan, Arimã, São Paulo de Olivença, Tonantins, Manacapurú, and Caviaña (opposite Manacapurú), Brazil.

As a series these differ from the birds of the lower Amazon in the paler coloration of the underparts, which is obvious in both sexes, but is most marked in the female. In males of *ridgwayi* the underparts are amber brown, as against deep tawny in the present race. Females of the latter are cinnamon buff below, instead of raw sienna. The two Amazon races agree in the rich bronzy or even purplish color of the upperparts. The name *Jacamerops isidori* of Deville (Revue Zoologique, 1849, 55) was evidently based on an extreme variant of this type, to judge from the colored plate in Des Murs (Castelnau Expedition, Zoologie, Oiseaux, 1855, pl. 10) and from Sclater's remarks on his examination of the type (Monograph Jacamars and Puff-birds, 1879, 60). Since this type-specimen came from eastern Peru, the name doubtless applies as well to the population of the upper and middle Amazon and the Rio Purús. Birds from these several regions agree *inter se*. They average slightly smaller than *ridgwayi*. Ten males measure: wing, 111-117 (average, 113.5); tail, 120-138 (129.5); bill, 48-53 (50.5).

***Jacamerops aurea penardi* Bangs and Barbour.**

Seven specimens: Cuabre and El Hogar, Costa Rica; El Tambor and Murindó, Colombia.

The describers based their name on four specimens, which they compared with a pair from Surinam and a female from the Brazilian "Amazons." The only diagnostic character they gave was the "much more slender bill," which character, although obvious upon comparison, is not well marked, and might well be disregarded in any study of this species. However, there are other differences of more account. Costa Rican birds have greener crowns than do those from French Guiana (typical or true *aurea*); the lower back, upper tail-coverts, wing-coverts, and inner secondaries are also purer green, with less bronzy suffusion. In all these respects our Colombian specimens agree with those from Costa Rica, and I refer them likewise to *penardi*. There are a few odd published records from Colombia, but this species must be rare there, as Chapman does not list it.

THE RACES OF *UROGALBA DEA* (Linnæus).

This species was long known as *Urogalba paradisea*, but the specific name *dea* is the one used in the tenth edition of Linnæus' "Systema Naturæ." Surinam is the type-locality, and there has never been any question as to the proper application of this name. The trouble started in 1855, when Sclater described his *Urogalba amazonum* from a specimen whose origin was questionable. Since that date various authors, including Sclater himself, and down to Griscom and Greenway (Bulletin Museum Comparative Zoölogy, 88, 1941, 186), have discussed the case and reached diverse conclusions. This confusion was due to the lack of sufficient material for study and comparison. The superb series of this species secured by Mr. Klages in various parts of its range now makes possible a study of geographical variation. From this study it appears that while *Urogalba dea dea* has constant characters and a definite range, at least three different races have been confused under the name *amazonum*. True *amazonum*, as I shall endeavor to show, is confined to the region south of the Amazon and east of the Rio Tapajóz. West of that stream, and thence to the Rio Madeira, it is replaced by a form which in its uniform pileum resembles typical *dea* but differs therefrom in proportions and in certain details of coloration. Oddly enough, it is this same form, or one practically indistinguishable, that ranges on the north bank of the Amazon from the Rio Negro west to Peru. And finally, on the south bank of the Amazon, west of the Rio Madeira, lives a small, short-tailed, brightly colored race with a parti-colored pileum. Let us consider these races separately.

Urogalba dea dea (Linnæus).

Forty specimens: Tamanoir and Pied Saut, French Guiana; Upper Arucauá and Obidos, Brazil.

This, the typical race, is characterized by its relatively long tail, its dark general coloration, bluish (rather than greenish) upper tail-coverts and tail, more bluish wings with less bronzy sheen, greater extent of chin-spot, and darker-colored and uniform pileum. Only one specimen in the series shows any trace of pale superciliaries. Obidos skins are precisely like those from French Guiana. This form ranges from the Guianas and upper Orinoco to the Amazon, and west to the Rio Negro (von Pelzeln). Hellmayr (Novitates Zoologicae, 14, 1907, 27) says that Natterer's specimens from Manaus and the upper Rio Negro agree in all respects with typical *dea*.

Urogalba dea amazonum¹ Sclater.

Twenty-eight specimens: Benevides, Colonia do Mojuy, Bella Vista, Miritituba, and Aveiros, Brazil.

In addition to these I have examined six specimens from the collection of the American Museum: Magoary (Marajó Island), Mocajuba (Rio Tocantins), Tauary (Rio Tapajóz), Caxiricatuba (Rio Tapajóz), and Porto de Moz (Rio Xingú), Brazil.

As shown by the series at hand, this form differs from typical *dea* in relative proportions: slightly longer wing, obviously shorter tail, and longer bill. It differs also in coloration: smaller brown chin-spot, greenish or bronzy (rather than bluish) tertiaries, upper tail-coverts, and tail; and in particular in the color of the pileum, which is light brown, with the tips of the feathers broadly brownish white. In some specimens the whole pileum is thus light colored; in others only the superciliaries are so marked. A specimen from the Rio Xingú closely resembles true *dea* in color, but by its measurements it must belong to *amazonum*.

In describing this form Sclater had but one specimen, purchased from a dealer, and without exact locality, but supposed to be from the "lower Amazon." Later, however (Monograph Jacamars and Puff-birds, 1879, 6), he came to consider this allocation an error, and accordingly substituted therefor "upper Amazonia" instead. To such absurd futilities were the ornithologists of that day reduced by their dependence on unscientifically collected material! Since birds from the lower and the upper Amazon respectively are recognizably distinct from each other, the origin of Sclater's type becomes important to discover. The specimen itself, now in the British Museum, would be desirable for comparison, but it is at present unavailable. Sclater's figure in his "Monograph" is not sufficiently definitive, but fortunately his measurements supply the necessary clue. They show that his type-specimen could have belonged only to the form which ranges south of the Amazon from the Pará district west to the Rio Tapajóz. The races from the upper Amazon are differently proportioned; their tails in particular are shorter. Hellmayr (*l.c.*) has arrived at precisely the same conclusion as regards the application of the name *amazonum*. I have before me the two specimens from the island of Marajó which he compared with the type. The westward range of this race is sharply limited by the Rio Tapajóz, as is that of so many other

¹ I accept this form of the word as the genitive plural.

birds; west of this stream the species is represented by another and different race, which I propose to call

***Urogalba dea brunneiceps*, subsp. nov.**

Thirty-three specimens: Villa Braga, Itaituba, Apacy, Tonantins, Manacapurú, Caviana, and Rio Manacapurú, Brazil.

Type, No. 98,508, Collection Carnegie Museum, adult "female" (= male?); Manacapurú, Rio Solimoës, Brazil, October 15, 1923; Samuel M. Klages.

Subspecific characters.—Similar to *Urogalba dea dea*, but differently proportioned (wing longer, tail shorter; bill longer), and coloration somewhat different; pileum averaging paler brown, uniform or sometimes with indistinct paler superciliaries; wing-coverts with more bronzy or greenish gloss; brown chin-spot averaging less extensive; and upperparts in general with the sheen more greenish, less bluish.

Range.—North bank of the Amazon, from the Rio Negro west to Peru, and on the south bank between the Rio Madeira and the Rio Tapajóz.

Remarks.—Numerous cases are known of birds from both banks of the Amazon being identical with each other, but it is indeed remarkable to find a characteristic north-bank form invading the south bank over a limited area, on either side of which it is represented by other races. No other such anomalous case comes to mind. However, close examination shows that birds from south of the great river are an incipient subspecies, since they tend to have the brown chin-spot smaller. Griscom and Greenway (Bulletin Museum Comparative Zoölogy, 88, 1941, 186) apparently did not detect the obvious differences between specimens from the right and left banks of the Rio Tapajóz, and listed them all as *amazonum*. However, there are three specimens from the left bank which show more or less decided pale superciliaries, as in that form; I consider them individual variants.

***Urogalba dea phainopepla*, subsp. nov.**

Fourteen specimens: Hyutanahan, Nova Olinda, Arimã, and São Paulo de Olivença, Brazil.

Type, No. 92,645, Collection Carnegie Museum, adult male; Arimã, Rio Purús, Brazil, September 5, 1922; Samuel M. Klages.

Subspecific characters.—Similar to *Urogalba dea amazonum* of the lower Amazon (Pará district), but decidedly smaller, and general coloration brighter, with the tail and its upper coverts usually more decidedly

greenish; wing-coverts and tertiaries more strongly washed with bronzy.

Range.—Brazil south of the Amazon and west of the Rio Madeira, and thence to Bolivia (Porto Velho, *fide* Cory).

Specimens from São Paulo de Olivença are not typical but in their darker and more uniformly colored pileums tend more or less toward *brunneiceps*. These two forms probably inosculate completely in Peru, but in Brazil they are certainly sufficiently distinct. The small size of this form in general, and its short tail in particular, as well as its obviously brighter coloration, are marked features when series are compared. It is certainly odd to find the two forms of this species with light-colored pileums, *amazonum* and *phainopepla*, separated in their respective ranges by a form in which the pileum is dark-colored and uniform.

MEASUREMENTS

Only fully adult birds in fresh plumage have been used in taking measurements. The tail-length naturally varies somewhat according to wear. The bill has been measured from the gape, to accord with Sclater's method. Unless otherwise specified, averages are based on a series of ten specimens.

Specimens	Wing	Tail	Bill
<i>Urogalba dea dea</i> :—			
Males.....	(87-92)89.8	(158-188)168	(58-68)61.3
Females.....	(85-89)87	(145-161)155	(49-61)55
<i>Urogalba dea amazonum</i> :—			
Males.....	(91-96)93	(150-174)160	(63-68)65.5
Type-specimen (<i>fide</i> Hellmayr).....	96	164	68.5
Females (7).....	(89-95)93.—	(140-153)147.5	(56-63)58.7
<i>Urogalba dea brunneiceps</i> :—			
Males.....	(87-95)92.6	(140-160)146.7	(63-70)66.6
Females.....	(87-94)89.8	(130-151)137.4	(56-63)60.1
<i>Urogalba dea phainopepla</i> :—			
Males (8).....	(88-93)90.6	(127-144)137.5	(56-65)60
Females (6).....	(85-91)88	(125-141)132.4	(56-60)58

THE GALBULA TOMBACEA GROUP.

The latest study of *Galbula tombacea* is by Hellmayr (Novitates Zoologicae, 17, 1910, 389, and Archiv für Naturgeschichte, 85, A, 1919, 118). He recognizes two races, *tombacea* proper and *cyanescens*. He attempts to restrict the latter to the south bank of the Amazon and assigns true *tombacea* to the north bank, and thence to Bogotá, Colombia. But the

matter of the respective ranges of the two forms and their taxonomy is not so simple as he supposes. With an ample series available for study, I wish to place my conclusions on record.

Galbula tombacea was described by Spix (Aves Brasiliae, 1, 1824, 55, pl. 58) from an unspecified locality on the Amazon River. We have five specimens from São Paulo de Olivença, ten from Panelas Island (near Tonantins), and four from a point opposite Tonantins. Note that they all come from the *south* bank of the river. It is nevertheless fair to presume that they represent Spix's bird correctly, and since he is known to have collected at São Paulo de Olivença, I suggest this as the type-locality for the species. Our birds compare favorably with specimens from eastern Ecuador (American Museum), but those in our collection average more coppery bronze above (the Tonantins skins especially); in this respect they therefore approach the birds about to be described from the middle Amazon, but the white chin-spot is not so well developed. The present species ranges west into Ecuador and Peru, the records from which countries Hellmayr has duly verified and summarized.

Galbula cyanescens was described by Deville (Revue et Magasin de Zoologie, (2), 1, 1849, 56) from "les bords de l'Amazone"; Hellmayr tells us that the types in the Paris Museum came from Sarayaçu, on the Ucayali River in northeastern Peru (a locality not to be confused with the Sarayaçu in eastern Ecuador). He lists specimens from seven other localities in central and southeastern Peru, among them Nauta, which is not only on the north bank of the Amazon but is also only fifty miles distant from Iquitos, where *G. tombacea* is known to occur. This circumstance, taken in connection with the fact that farther down the river *tombacea* crosses to the south bank, goes far to suggest that we are dealing here not with representative subspecies, as has been supposed, but with two distinct specific types, whose ranges appear to inosculate if not to overlap.

Our series of forty specimens of *cyanescens* come from the Rio Purús (Hyutanahan, Nova Olinda, and Arimã). This form is constantly larger than *tombacea*; it differs in its glossy pileum and virtual lack of a chin-spot. There is not any suggestion of actual intergradation between the two forms. Variation affects the amount of coppery sheen on the upperparts, and also the color of the crown, which in some individuals is greenish, in others more bluish. The case for specific status of *tombacea* and *cyanescens* is strengthened by analogy when we consider that there is a third member of this compact group, *Galbula pastazæ* Taczanowski and von Berlepsch,

closely allied but clearly specifically distinct. We have one specimen of this form from Arimã on the Rio Purús. Chapman (Bulletin American Museum Natural History, 55, 1926, 352) calls it a Subtropical Zone form, but this specimen does not confirm this allocation.

Specimens of *tombacea* from eastern Colombia (five skins from the American Museum) are by comparison with Ecuador examples more purely green, less bronzy, above; if this character is borne out by a larger series, they would be entitled to stand as a subspecies, for which Sclater's name *fuscicapilla* (1855) would be available. The bird of the middle Amazon too appears to be entitled to formal recognition, and I call it

***Galbula tombacea mentalis*, subsp. nov.**

Five specimens: Caviana and Rio Manacapurú, Brazil.

Type, No. 98,990, Collection Carnegie Museum, adult male; Caviana (opposite Manacapurú), Rio Solimões, Brazil, January 16, 1924; Samuel M. Klages.

Subspecific characters.—Similar to *G. tombacea tombacea* of the upper Amazon, but upperparts more heavily glossed with coppery bronze; posterior half of crown glossed with bluish green (more strongly in the male); and white chin-spot larger.

Range.—Middle Amazon Valley (both banks), west of the Rio Negro and Rio Madeira.

Remarks.—Although at first glance the characters of this race would suggest that it is a form intermediate between *tombacea* and *cyanescens*, I do not so consider it. I believe that its affinities are wholly with the former. From Hellmayr's remarks (Novitates Zoologicae, 17, 1910, 390) I infer that it is this form that occurs at Humaythá, on the Rio Madeira. The present records involve a considerable eastward extension in the known range of *G. tombacea*.

NOTE ON *GALBULA LEUCOGASTRIS* VIEILLOT.

"Cayenne" is the type-locality of this species, as designated by Hellmayr (Novitates Zoologicae, 17, 1910, 390). We have seventeen specimens from the following localities: Tamanoir, French Guiana; Upper Arucauá, Villa Braga, Miritituba, Nova Olinda, and Arimã, Brazil. Although it is claimed to be "distinct at a glance," I am unable satisfactorily to distinguish Griscom and Greenway's *viridissima* (Bulletin Museum Comparative Zoölogy, 88, 1937, 426). So far as I can see our three birds from the Rio Tapajóz are precisely like the others. There is no difference

in color, and the variation in the length of the tail overtops the stated differences in this respect between the two supposed forms. However, I note that not one of our specimens is as green as Sclater's figure (Monograph Jacamars and Puff-birds, 1880, pl. 9) represents. This plate was based on specimens from the Rio Negro. Further investigation of this case is needful. On the claim that *G. leucogastris* and *G. chalcothorax* intergrade I can express no opinion.

ON BRACHYGALBA GOERINGI SCLATER AND SALVIN.

Of this little-known species we have fifty-one specimens from El Trompillo, Carabobo, Venezuela, and twelve from Palmar, Boyaca, Colombia. The Venezuelan skins are virtual topotypes, but on comparing them with the original description and plate (Proceedings Zoological Society of London, 1869, 253, pl. 18) I find several discrepancies. There is absolutely no difference—not even an average one—between the sexes, both of which possess a broad, well-marked rusty band across the middle of the abdomen. However, the plate represents the male bird as having the abdomen pure white. The color of the upperparts is not “bronzy green,” but steel blue, although the feathers are more greenish subterminally, and brown basally. The pectoral collar and the sides of the body are brown, not blackish; there is no indication of a pale superciliary stripe in adult birds, nor is the nape fulvous, but instead merely a little paler than the crown. In a young bird with a short bill (No. 47,421, May 27), however, the nape, superciliaries, and sides of the head are fulvous-tinged; the back, wings, and tail are greenish, with each feather margined and tipped with ferruginous; and the dark-colored pectoral collar and sides are broken by whitish or buffy feather-tipping. Several other longer-billed specimens show similar indications of immaturity. It is quite possible that Goering's specimens were not fully adult.

I am unable to distinguish our series from Palmar (in the Tropical Zone east of the Eastern Andes) from Venezuelan birds (*cf.* Underdown, Auk, 46, 1929, 240). This record involves a great extension of the known range.

A NEW BRACHYGALBA FROM BRAZIL.

***Brachygalba phæonota*, sp. nov.**

Type (and only specimen), No. 96,979, Collection Carnegie Museum, adult female; Tonantins, Rio Solimoës, Brazil, June 28, 1923; Samuel M. Klages.

Description.—Upperparts dark brown (bister), the pileum a little paler (sepia); wings and tail black with a faint steel blue gloss, the former with a narrow white band underneath, at the base of the remiges; throat, breast, sides, and under tail-coverts dark brown like the upperparts, leaving only the middle of the abdomen soiled white; feathers of the chin and upper throat with faint whitish shaft-stripes and rufescent tips; "iris milky white; feet blackish; bill black." Wing, 71; tail, 53; exposed culmen, 43.

Range.—Certainly known only from the type-locality.

Remarks.—This species resembles *B. lugubris* (Swainson), described from British Guiana, and of which we possess authentic specimens from eastern Venezuela, close to the Guiana frontier. It differs from that species in its uniformly darker (more brownish, less rufescent) coloration, in its lack of any white over the eye, and in its dark-colored throat, with just the faintest possible suggestion of a pale submaxillary line on either side. The *Galbula inornata* of Sclater (Jardine's Contributions to Ornithology, 1852, 32) was later synonymized with *lugubris* by Sclater himself. Like so many of the species described in the early days, its exact home was unknown, but was surmised to be the upper Amazon Valley. The original description leaves much to be desired, but the figure in Sclater's Monograph (pl. 11, right-hand figure) seems to have been based on the type-specimen of *inornata*—the only one in his collection without definite locality. This figure is a perfect likeness of *B. lugubris* as represented by our Venezuelan specimens, but it does not answer at all for the Tonantins bird. Taczanowski (Ornithologie du Pérou, 3, 1886, 120) also describes a Peruvian specimen which he calls *inornata*, but again the description seems to indicate a bird with earthy brown upperparts and a distinct superciliary stripe. I think the Tonantins bird must be new, but more specimens are naturally desirable.

CRITICAL REMARKS ON *NOTHARCHUS HYPERRHYNCHUS*.

Since discussing this species some years ago (Annals Carnegie Museum, 14, 1922, 229), I have re-examined the case in the light of new material and new developments. The receipt of a series from the Amazon Valley has been the occasion for taking up the question again. Birds from the lower Amazon have been discriminated by Sassi under the name *paraensis* (Ornithologische Monatsberichte, 40, 1922, 121). In this form the maximum in size of bill is reached for this species. It was described from the Pará region, and reaches its western limit at the Rio Tapajóz, beyond

which it is replaced by typical *hyperrhynchus*. We have specimens from Santarem and Colonia do Mojuy.

From the middle and upper Amazon, west of the Rio Negro and the Rio Tapajóz, we have five specimens of *hyperrhynchus*. The only difference that I can find between Amazonian and Costa Rican skins is that the latter have slightly more dark mottling on the white breast and sides of the head than do the former. Also, the white band on the forehead averages narrower, but since this is affected by the makeup of the skin, its value as a differential character is lessened. Bolivian birds (seven specimens) are the same, too, except that the white parts are faintly buffy, but I think this is an adventitious stain. We have five birds from the Santa Marta region and two from Jaraquiel, Colombia. On closer examination I find that all these have brownish wings, which I ascribe to immaturity. Their breast-bands are on an average narrower, and if this feature is not due solely to the compressed makeup of the skins and is found to hold in fully adult individuals, it might suffice to set off the birds of the Colombian Caribbean littoral as a recognizable race. But as matters stand now, I shall have to call them *hyperrhynchus*, like the rest. Chapman (Bulletin American Museum of Natural History, 55, 1926, 354) has reached the same conclusion as to the application of the name. And now comes Van Rossem (Transactions San Diego Society of Natural History, 8, 1934, 3-4), declaring that he can make out no variation within the Central American range of *dysoni*. If he is correct, this name will have to go. This opinion was to some extent foreshadowed by Sclater (Monograph Jacamars and Puff-birds, 1880, 67-72), who remarked on the several supposed forms occurring together.²

Ridgway (Bulletin U. S. National Museum No. 50, part 6, 1914, 375) was able to distinguish *dysoni* from *hyperrhynchus* only by the larger bill of the latter, but it is significant that he made his comparisons with specimens of *paraensis* and not with typical *hyperrhynchus*.

So far as I can discover, this species has not been recorded hitherto from Bolivia. Our specimens from that country come from Buena Vista, near Santa Cruz de la Sierra. We also have a single specimen (No. 90,915) from Guachi, Zulia, Venezuela, that may represent a recognizable form from the Maracaibo Basin. It is apparently adult but has considerable dark mottling and streaking on the breast and the sides of the head; the breast-band is comparatively narrow.

² Since the above was written I find that Sassi (Temminckia, 4, 1939, 161-162) has independently reached the same conclusion.

I consider *Notharchus macrorhynchos* of Guiana a closely allied but distinct species.

THE RACES OF *NYSTACTES TAMATIA* (GMELIN).

Nystactes tamatia, like many other sedentary species of the Brazilian forest region, varies geographically, and the Amazon and its larger affluents tend to limit the respective ranges of its component races. For a long time only two races were recognized: true *tamatia* of the Guianas and the lower Amazon and *pulmentum* of the upper Amazon. In 1910, Hellmayr (Novitates Zoologicae, 17, 1910, 391-2) pointed out the existence of a third race, *hypnaleus* of Cabanis and Heine, in the Pará district, and in 1921, Cherrie and Reichenberger (American Museum Novitates No. 27, 1921, 3) described a fourth, *interior*, from Matto Grosso. The last I have not seen, but with the material before me I have no trouble in discriminating the other three races; and there are two more which appear to be worthy of recognition by name. Typical *tamatia* is the most lightly spotted below of all the forms; in depth of color of the throat and breast it is intermediate between *hypnaleus* and *pulmentum*. Cayenne is the type-locality; and while we have no specimens from there, I assume that our Obidos skins (three) are typical, as do also Griscom and Greenway (Bulletin Museum Comparative Zoölogy, 88, 1941, 190). However, these authors avoid the determination of the specimens from the west bank of the Rio Tapajóz. (Incidentally, they list three specimens from Villa Braga by mistake, since we have only one from that place, and two from Apacy.) I am unable to differentiate these Rio Tapajóz birds from those from Obidos. The alleged difference in the length and shape of the bill fails to materialize upon measurement. It appears, therefore, that *tamatia* proper crosses the Amazon to occupy the territory between the Rio Tapajóz and the Rio Madeira. East and west of this zone, however, the species is represented by races whose respective ranges are separated by the Amazon. I have examined four specimens of *tamatia* from Borba, on the lower Rio Madeira, in the collection of the American Museum, also four from Santa Clara, Villa Bella Imperatriz, on the south bank of the Amazon.

In *Nystactes tamatia hypnaleus* of Cabanis and Heine (twenty-five specimens examined) the spotting of the underparts is denser, and the throat and breast are more ochraceous, than in the typical race. In *pulmentum* (nine specimens from the Rio Purús and Tonantins, on the Rio Solimoës) the spotting below is likewise fairly heavy, but the throat

and breast are much paler, these parts being merely washed with buff. A series of eleven specimens from Caviana, on the south bank of the Amazon opposite Manacapurú, however, appear to be separable from *pulmentum*, and I call them

***Nystactes tamatia punctuliger*, subsp. nov.**

Type, No. 99,068, Collection Carnegie Museum, adult male; Caviana, Rio Solimoës, Brazil, January 22, 1924; Samuel M. Klages.

Subspecific characters.—Similar to *Nystactes tamatia pulmentum*, but underparts more heavily and densely spotted, and upperparts slightly but constantly darker brown.

Range.—Known only from the type-locality.

Remarks.—The exact limits of the range of this new race remain to be worked out. It is likely that the Rio Madeira cuts it off from *tamatia* proper, while to the west it doubtless intergrades with *pulmentum* on the Rio Purús. On the opposite (north) bank of the Amazon it is represented by a closely allied but apparently distinct race,

***Nystactes tamatia inexpectatus*, subsp. nov.**

Type, No. 99,562, Collection Carnegie Museum, adult male; Manacapurú, Rio Solimoës, Brazil, June 13, 1924; Samuel M. Klages.

Subspecific characters.—Similar to *Nystactes tamatia punctuliger* nobis, but throat and breast more deeply colored, ochraceous buff instead of buffy white.

Range.—Known only from the type-locality.

Remarks.—In this race, which hails from the north bank of the Amazon, west of the Rio Negro for an unknown distance, the underparts are as heavily and densely spotted as in the birds from the south bank; but the throat is much deeper ochraceous—exactly as in typical *tamatia*—and the upperparts are deep brown. One of our two males is a young bird in moulting plumage, but the other is an adult whose characters give it distinction.

NOTE ON NYSTALUS STRIATIPLECTUS (SCLATER).

It has become the fashion to submerge this form as a subspecies under *maculatus*. Although their close relationship may be admitted, there is as yet no satisfactory proof of intergradation. The form *pallidigula* of Cherrie and Reichenberger (American Museum Novitates No. 58, 1923, 6), if valid, clearly belongs with *striatiplectus*, but *parvirostris* of Hellmayr

(Novitates Zoologicae, 15, 1908, 86) is just as clearly a race of *maculatus*. The describers of *pallidigula* say that their bird from Matto Grosso is "much smaller, the bill especially being weaker" than in *striatipectus*, but their measurements (based in part upon our material, twenty-nine specimens in all from Bolivia and Argentina) fail to bear this out, so that the only diagnostic character is the different coloration.

A NEW MALACOPTILA FROM COLOMBIA.

Malacoptila panamensis magdalenæ, subsp. nov.

Type, No. 58,908, Collection Carnegie Museum, adult female; El Tambor, Santander, Colombia, December 5, 1916; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Malacoptila panamensis panamensis* (as represented by specimens from the lower Atrato River and southwestern Costa Rica), but the coloration of the underparts is much lighter; the dark streaks on the lower breast are not so heavy, and are dusky rather than brownish in tone. Wing (type), 91; tail, 75; bill, 25; tarsus, 16.

Range.—Magdalena Valley in Colombia (exact limits not known).

Remarks.—It has been supposed that in Colombia *Malacoptila panamensis* was confined to the Pacific coast region, whence it extended into Panama. But the acquisition of the present series of six specimens shows that its range must include the Magdalena Valley as well. Consequently it is no surprise to find that the population of this region constitutes an undescribed race, easily recognizable by its extensively white underparts in both sexes, with a corresponding reduction in the dark streaking of the lower breast and the sides of the body. The throat and upper breast are tawny buff, in contrast to the rest of the underparts; by this token the new form differs from *fuliginosa* of eastern Costa Rica and resembles true *panamensis*. In the color of the upperparts it also resembles the latter form.

M. panamensis must now be added to the list of species inhabiting alike the Tropical Zone of both the Magdalena Valley and the Pacific coast region of Colombia. I cannot agree with Bangs (Auk, 24, 1907, 294) that this species has a gray and a rufous phase independent of age, sex, or season. Certainly this statement is not borne out by the series at hand (all the forms taken collectively). The males are rufous, the females gray, just as Ridgway describes them. In the few cases where the plumage disagrees with the sex-mark, there is reason to believe that the latter is a mistake. Incidentally, females tend to be larger, not smaller, than males.

NOTE ON MALACOPTILA ASPERSA SCLATER.

With a single specimen before them from Las Quiguas, northern Venezuela, Hellmayr and von Seilern (Archiv für Naturgeschichte, 78, A, 1912, 156) unhesitatingly identify it with the *Malacoptila aspersa* of Sclater, which was somewhat doubtfully ascribed to Venezuela, but was later repudiated by Sclater himself. Oddly enough, they allow it specific rank on the basis of the characters shown by their specimen. It so happens that we have four specimens (one male, three females) from Las Quiguas, but these do not show any special peculiarities as compared with Colombian skins of *M. mystacalis*. Now, with six more Venezuelan skins available, I find that they are paler below on an average than most Colombian skins, but so many of the latter are just as pale that no formal separation is desirable or advisable. Consequently I do not recognize *aspersa* even as a subspecies, but I refer all our specimens to a single somewhat variable species, peculiar to the Subtropical Zone of Colombia and the coast range of Venezuela. The differential characters of this form have been succinctly defined by Hellmayr (Proceedings Zoological Society of London, 1911, 1197).

MONASA M. MORPHÆUS AND M. M. PERUANA.

The typical race is represented in our collection by twenty-seven specimens: Benevides, Santarem, Colonia do Mojuy, and Miritituba, Brazil. Ridgway's description of *Monasa rikeri* from Santarem was obviously based on a misunderstanding of the characters of *morphæus*, of which his name is a synonym. The character of the color of the malar apex is inconstant, as our series shows. Since Hellmayr (Field Museum Zoological Series, 12, 1929, 429) says that Pará specimens of *morphæus* agree with others from Bahia and Rio de Janeiro, the identity of our series listed above may be regarded as settled. Ten females measure as follows: wing, 118-132 (average, 127); tail, 112-128 (119.5); bill, 32-36 (34.4). I have selected females for measuring because they are generally larger than males, and because they are better represented in our series. It is quite possible that the minimum figures here quoted may actually refer to a wrongly sexed example.

Of the smaller race, *peruana*, we have thirty-five specimens from the middle and upper Amazon and the Rio Purús, as follows: Hyutanahan, Arimã, São Paulo de Olivença, Tonantins, Manacapurú, and Caviana, Brazil. Ten females measure: wing, 118-127 (123); tail, 106-114 (111);

bill, 30-33 (31.9). The only difference, so far as I can see, between *morphæus* and *peruana* is the smaller size of the latter, expressed in these measurements. I can find no difference in general coloration, in the extent of the white capistrum, or in the shape of the bill. If allowance is made for some of the examples measured which may have been wrongly sexed, my figures correspond very well with Ridgway's.

Griscom and Greenway (Bulletin Museum Comparative Zoölogy, 88, 1941, 192) refer all the specimens in our collection from the Rio Tapajóz to *morphæus* without apparent hesitation. So far as those from Santarem and the right bank in general are concerned, they are doubtless correct, but I find that birds from the left (west) bank of this river are practically inseparable from *peruana*, with which their measurements agree well. Ten females measure: wing, 116-125 (120); tail, 103-113 (110); bill, 30-33 (31.6). Our Rio Tapajóz specimens number twenty-two, from the following localities: Villa Braga, Itaituba, and Apacy.

I may here call attention to a minor error by Griscom and Greenway (*l. c.*, 193) in listing a specimen of *Monasa atra* from Obidos under *M. n. nigrifrons*.

THE GENUS NONNULA SCLATER.

Nonnula amaurocephala Chapman is represented in our collection by six topotypes from Manacapurú, Brazil. The sexes are alike so far as I can see. "Iris seal; feet plumbeous; maxilla black with lateral triangle of blue-gray from below the nostril halfway to the apex, also a line of the same color along edge of the gape; mandible blue-gray with black tip" (Klages).

Nonnula sclateri Hellmayr is represented by four specimens from Arimã, Rio Purús. This stands as the second locality for this species, heretofore known solely from the type-specimen from Humaythá, on the left bank of the Rio Madeira. Our specimens correspond closely to the original description and later remarks by Hellmayr.

On geographical grounds I strongly suspect that the *Nonnula* secured by Natterer at Borba, on the right bank of the Rio Madeira, and discussed by Hellmayr, *Novitates Zoologicae*, 17, 1910, 393, belongs to my lately described *N. rubecula simplex* (*Annals Carnegie Museum*, 25, 1937, 248) and not to *N. r. cineracea*. Of the latter we have six specimens from Hyutanahan (Rio Purús) and São Paulo de Olivença. The type of this form came from the Rio Javarri, a locality which ties in well with the two localities specified.

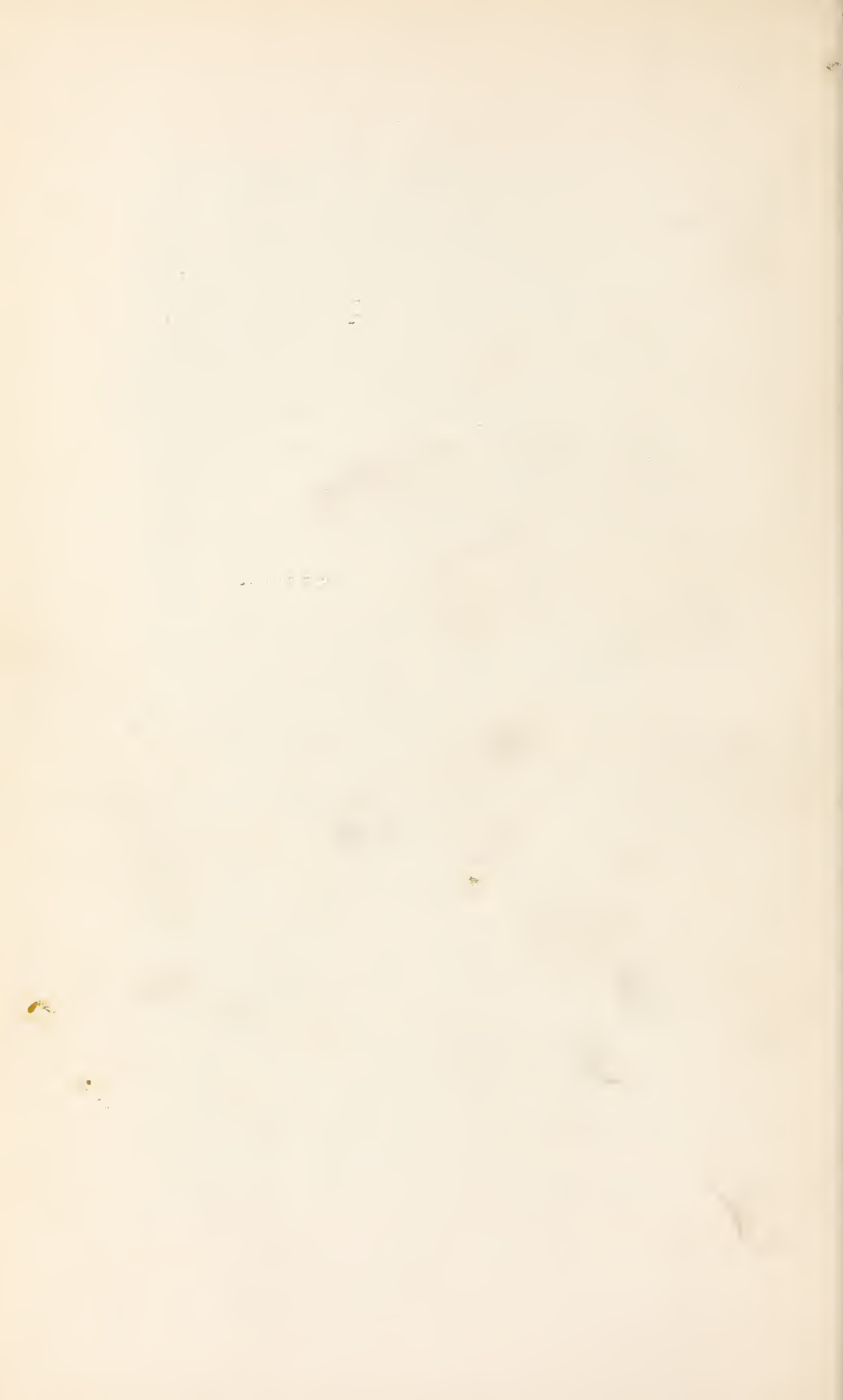
Our eleven specimens of *N. rubecula* from Tonantins, on the north bank of the Amazon, however, appear to be referable to the *Nonnula duidæ* of Chapman (Bulletin American Museum Natural History, 33, 1914, 195), which I would reduce to the rank of a subspecies. I am indebted to Mr. John T. Zimmer for a direct comparison of these specimens with the type of this form. Compared with *N. rubecula cineracea* of the upper Amazon (south bank), their coloration is brighter, and their color pattern is more sharply defined. The upperparts are sepia, with the pileum darker and more slaty (Chætura drab), and the eye-ring white; the rufous loreal spot and the black maxillary spot are well defined; the abdomen and under tail-coverts are white, laterally washed with buff; and the rest of the underparts are buckthorn brown (instead of tawny olive, as in *cineracea*).

This is a well-marked form, although the comparative differences have to be seen in order to be fully appreciated. The duller-colored *cineracea* has the colors more blended and is sordid-looking by comparison. *N. r. simplex* of the Rio Tapajóz is still more different.

We have also a single specimen (No. 77,912) of a *Nonnula* of the *rufipectus* group from Aveiros, on the east bank of the Rio Tapajóz—a locality far to the east of the known range of this species. This specimen was overlooked by Griscom and Greenway in listing our Amazonian material. Mr. John T. Zimmer has kindly compared it with the material in the American Museum and reports as follows:

"The *Nonnula* appears to be not fully adult and it is difficult to say which of its characters, if any, are due to this fact. However, it is more deeply rufous below than either *ruficapilla* or *rufipectus* and has the under tail-coverts more strongly ochraceous buff than in the extremes of *ruficapilla*. The flanks are more strongly cinnamomeous than in either of the forms mentioned. The tail is slightly darker than in *rufipectus* but much paler than in *ruficapillus*. The crown and forehead are paler than in *ruficapilla*, but darker than in *rufipectus*. The back of the head is less strongly rufous than in adults of either form, possibly because of immaturity. The hindneck is browner and less grayish, possibly for the same reason. The bill is the size of that of *rufipectus* but smaller than in *ruficapilla*. The yellow at the base of the bill is shown by some examples of the others. On the whole, if the characters here noticed are constant, your bird represents a new subspecies. There are no records from the Tapajóz region of any form, so far as I know. It is not *nattereri* (of which *pallida* is a synonym), since that is a much paler form."

I do not now venture to formally describe this supposed new form.



507.73
PA P6842

replaced

ART. II. SOME LARGE STRAIGHT ORDOVICIAN
CEPHALOPODS FROM MINNESOTA

BY A. K. MILLER AND BERNHARD KUMMEL



Annals of the Carnegie Museum

Vol. XXX, p. 19-38

Issued March 13, 1944

Pittsburgh, Pa.

ART. II. SOME LARGE STRAIGHT ORDOVICIAN CEPHALOPODS FROM MINNESOTA

BY A. K. MILLER AND BERNHARD KUMMEL
THE STATE UNIVERSITY OF IOWA

(PLATES I-IV)

It has been known for a long time that during the Ordovician period, cephalopods, as a class, were most probably the largest animals extant, and some of the straight forms are estimated to have attained a length of as much as fifteen feet. At many localities large specimens are abundant, and almost all natural history museums display well preserved individuals. Therefore it is somewhat of a surprise to find that the literature contains very few good illustrations and detailed descriptions of these large forms. Perhaps it is because "familiarity breeds contempt" and particularly because of the excessive amount of work involved in dealing with heavy and more or less fragmentary specimens. That is, it is difficult indeed to collect these large specimens without breaking them, and few reasonably complete individuals have been obtained.

Moderately large orthocones were recorded long ago from the European Ordovician, and almost one hundred years ago Hall described comparable forms from contemporaneous beds in New York. Also, as early as 1856, Woodward studied a Chinese specimen 29 inches long, and it is now known to be Ordovician in age. Perhaps the major contribution to our knowledge of these Early Paleozoic giants is contained in Clarke's report on "The Lower Silurian Cephalopoda of Minnesota," published in 1897. During the preparation of that study, Clarke examined a number of large specimens and for reasons not entirely clear referred most of them to *Endoceras* ["*Cameroceras*"] *proteiforme* Hall, the holotype of which is of relatively modest proportions. Clarke of course emphasized the "enormous size" of the specimens he had under consideration, and he observed that the dimensions attained were indicated by an incomplete internal mold of a siphuncle "measuring 3 feet 3 inches in length." Also, he stated that "entire shells referable to this species have been found with a length of ten to fifteen feet," though all of the material available to him was of a smaller size.

In 1932 Miller described as *Endoceras giganteum* a large incomplete

MAR 23 1948

crushed specimen from the Ordovician Bighorn formation of Wyoming and concluded that originally it "must have been somewhat comparable in length" to the largest of the Minnesota specimens mentioned by Clarke. Miller also pointed out that "for the most part, the descriptions and illustrations of the large specimens (probably representing more than one form) that have been referred to *Endoceras proteiforme* are not adequate for comparisons." For example, Clarke unfortunately included in his report only an outline sketch of his large specimen.

Through the courtesy of the Carnegie Museum, we have been permitted to study an extensive collection of exceptionally fine large nautiloids from the Ordovician of Minnesota. The labels which accompany this collection indicate that the specimens were obtained long ago from "Trenton limestone" in the Lindersmith quarry near Owatonna, Steele County, Minnesota. In a report on the geology of Steele County, published in 1876, Harrington mentions the Lindersmith quarry, states that the rock exposed there is "Trenton limestone," and adds that the quarry is located in sec. 28, T. 108 N., R. 20 W., north of Owatonna and just south of Clinton Falls. Stauffer and Thiel (1941, p. 198), in their recent report on the Paleozoics of Minnesota, state that a present-day quarry, the Klemmer Rock Quarry, in the southeast corner of Section 28 about one mile south of Clinton Falls, exposes eight feet of Stewartville shale and limestone and 27 feet of Dubuque limestone with some shale—they regard the Dubuque as a member of the Maquoketa formation. In a personal communication dated December 4, 1942, Stauffer writes:

"There are several old quarries in Section 28 and also in Section 33, T. 108 N., R. 20 W., to the south of Clinton Falls, Steele County, Minnesota. They lie along both sides of Straight River and are not very far distant from it. None of them ever amounted to much and none extend much below the water level in the adjacent river. The beds exposed in these old pits are entirely in the Maquoketa [which is here interpreted as including the Dubuque]. Mr. W. R. Lindersmith owns the land (164 acres), but I do not know that he ever operated the quarries. They were old abandoned quarries the first time I saw them some twenty years ago. None of the old pits were more than from eight to ten feet deep. The section we give on page 198 is of the new quarry opened a few years ago by the Klemmer Construction Company. It is on the public road along the west side of the river farther upstream and about three or four times as deep as the old pits. It is the only large scale quarrying ever done on the section.

"No complete collection of the fauna at the new locality was made when we were working in that region. It was an extremely active place and geologists were a bit of a nuisance at the time. I do not recall *Endoceras* as an especially abundant fossil in the lower beds of the [Dubuque "member" of the] Maquoketa [which are some 7 feet thick], but I am of the opinion that Dr. Tolmachoff's [the Carnegie Museum] collection came from the more fossiliferous upper beds in one of the old quarries where Endoceratoid cephalopods are common."

It therefore seems clear that the specimens we have under consideration came from well up in the Dubuque limestone, the age of which is a moot question. Kay regards it as belonging in the upper Middle Ordovician, whereas Stauffer and Thiel place it as basal Upper Ordovician. Perhaps, it should be stated here that in this general area large straight cephalopods occur in the Ordovician beds that underlie the Dubuque, that is, in the Platteville, Decorah, and Galena formations, as well as in the overlying Maquoketa.

The photographs which accompany this report were retouched by Mr. John Carrier. Also, we wish to acknowledge our indebtedness to the Graduate College of the State University of Iowa, which made the work financially possible.

SYSTEMATIC PALEONTOLOGY

Genus *ENDOCERAS* Hall, 1847

Genotype: *Endoceras proteiforme* Hall

In the first volume of the *Palaeontology of New York*, Hall established this genus for orthoceraconic nautiloids with large excentric siphuncles in which there are endocones. Throughout the volume, he referred numerous species from the Ordovician of New York to the genus, but he did not designate a genotype. In 1915, Bassler, probably following Clarke (1897, p. 775), listed as the "accepted genotype," *Endoceras proteiforme* Hall, a species described in the same volume in which the generic name *Endoceras* was proposed. There is, to be sure, some question as to whether or not Bassler can be said to have established the genotype, particularly since the International Rules of Zoological Nomenclature emphasize that in selecting a genotype an author must be quite definite. Throughout most of his studies of Paleozoic cephalopods, Foerste seems to have been uncertain as to whether or not *E. proteiforme* should be regarded as the

valid genotype. However, in 1930, Teichert (and in 1932, Foerste) definitely listed it as such and thereby established its validity, if it had not been established previously. Insofar as we have been able to ascertain, in the meantime no other species has been designated as genotype, though Foerste pointed out several times that *E. subcentrale* Hall was the first species to be described by Hall under the generic name.

Endoceras proteiforme Hall is now well known, for Foerste has restudied the type specimens and designated one of them as the holotype. This specimen came from the Trenton limestone at Middleville, New York. As pointed out by Bassler in 1915, this "species has been identified from almost all of the Mohawkian and Cincinnati formations of the United States and Canada" but "undoubtedly" a "variety of forms" has been included.

From a study of Foerste's illustrations and descriptions of the geno-holotype, and numerous similar forms, we have drawn up the following generic diagnosis of *Endoceras*:

Conch long, slender, straight, and rather gradually expanded orad, that is, orthoceraconic. Cross section circular or slightly depressed dorsoventrally. Aperture apparently unmodified. Surface of test smooth or bearing small transverse annulations that are surficial (so that internal mold is essentially smooth). Sutures straight and directly transverse or in depressed conchs forming shallow dorsal and more prominent ventral lobes (due to a ventral flattening of the conch). Siphuncle large, ventral and in some cases marginal in position, and holochaoanitic in structure. Adapical portion of siphuncle contains numerous closely invaginated endocones which are long and slender.

Perhaps the most significant character of this genus is the large holochaoanitic siphuncle, which in many cases has a diameter equal to almost half that of the conch. Each septal neck is long enough to invaginate into the infundibular adoral end of the next neck apicad. The siphuncle is therefore composed entirely of septal necks, for no connecting rings are present. As in most holochaoanitic forms, the siphuncular segments are distinctly concave exteriorly.

Presumably the closely invaginated endocones in the adapical portion of the siphuncle of mature individuals served as ballast. As shown by text figure 1, Hyatt observed an endosiphotube extending through the apices of these endocones. Kobayashi also has indicated the presence of an endosiphotube here, but none of the specimens studied by us has this portion of the conch well preserved. We have, however, found an

endosiphotube to be present in a related holochoanite, *Cassinoceras amplum* (Dawson), of the Lower Ordovician of southern Quebec. In that form, at irregular intervals there are partitions across the endosiphotube.

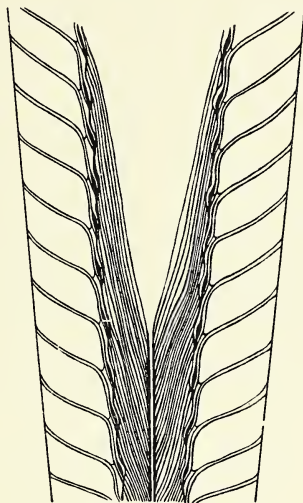


FIG. 1. Diagrammatic median longitudinal section of *Endoceras proteiforme* Hall(?), from the Ordovician of New York, showing endocones and an endosiphotube. After Hyatt.

Such are not shown by Hyatt's figure, but he may possibly have overlooked them.

In many specimens belonging in the genus *Endoceras*, the siphuncle contains an internal mold of the adoral endocone and this has been termed a spiculum. Not infrequently the spiculum has been preserved whereas the endocones have not. It seems likely that the endocones were composed entirely of aragonite and were therefore not likely to be preserved.

Both Bassler and Teichert indicate that the genus *Endoceras* was established by Hall in 1844. It is true that in the *Abstract of the proceedings of the fifth session of the Association of American Geologists and Naturalists*, published in the American Journal of Science and Arts in that year, Hall (p. 109) discussed orthoceratoids that contained endocones and concluded that the structures they exhibited "may serve as the foundation of generic distinction." However, insofar as we have been able to ascertain, no name was published for the genus until 1847.

The genotype of *Vaginoceras* (*Endoceras multitubulatum* of the Black

River limestone of New York) is poorly known, but it appears to be congeneric with the genotype of *Endoceras*. *Vaginoceras* should therefore be suppressed as a synonym of *Endoceras*, which has priority.

Endoceras resembles rather closely *Camerocheras* and *Cyclendoceras*, both of which occur in association with it. Representatives of *Camerocheras* can be distinguished by the fact that the spiculum is short, rapidly expanded orad, slightly curved, and annulated. The spiculum in *Cyclendoceras* is similar to that of *Endoceras*, but the conch and also the internal mold bear large rounded annulations which are not parallel to the sutures and which are quite distinctive.

Endoceras is one of the few Early Paleozoic genera that are known to have an essentially world-wide distribution. Representatives of it have been found at many widely separated localities in North America, Europe, Asia, and Australia. Stratigraphically it ranges throughout most of the Ordovician, and possibly into the Silurian and even the Devonian. The oldest forms that can be unequivocally referred to it are from the Lower Ordovician Powell dolomite of Arkansas. In the Middle and Upper Ordovician, *Endoceras* is exceedingly abundant in North America, Europe, and Asia. Although several species from the Silurian have been referred to the genus by different authors, we have not been able to satisfy ourselves that valid representatives occur in that system. Also, although we have not seen the specimen, we are inclined to doubt that the Devonian form mentioned by Foerste (1925, p. 15) belongs in this genus.

***Endoceras clarkei*, sp. nov.**

(Plate I, figures 1-3; Plate II, figures 1, 2;
Plate III, figure 2; Plate IV, figure 2)

1897. *Camerocheras proteiforme* [part] Clarke, Minnesota Geol. and Nat. Hist. Survey, vol. 3, pt. 2, pp. 777-779, pl. 48, figs. 1, 2; pl. 49, fig. 2; pl. 50, figs. 1, 2; pl. 51, figs. 1-3; pl. 53, figs. 4, 5. [Not *Endoceras proteiforme* Hall, 1847.]

Conch large, rather gradually expanded orad, and circular or (due to dorsoventral depression) broadly elliptical in cross section. Surface of test bears small rounded annulations that are essentially straight and directly transverse. Internal mold smooth and marked only by sutures. Camerae short and sutures, like annulations, are essentially straight and directly transverse. Siphuncle large, subcircular, and ventral but not quite marginal.

Of the numerous specimens available to us for study, that represented by figures 1 and 2 on Plate I seems to be the best from several points of view. We are therefore designating it as the holotype of the new species, even though it is much smaller than some of the specimens that we are including in the species. This specimen is septate throughout. It is about 165 mm. long, and its width increases from some 50 mm. near its adapical end to about 64 mm. near its adoral end. Its maximum height, which is attained at its adoral end, is only about 47 mm., but clearly the conch has been crushed dorsoventrally. This specimen retains a considerable portion of the test (or a replacement of it), and this shows that the surface of the test (but not the internal mold) bears small rounded annulations which are of about the same size as the intermediate grooves and are essentially straight and directly transverse. On the adoral portion of the holotype, the crests of these annulations are on the average about $5\frac{3}{4}$ mm. apart and they rise almost 1 mm. above the bottoms of the adjacent grooves. Also, on what appears to be an inner layer of the test, there are fine vertical lirae.

The surface of the internal mold is essentially smooth, and for the most part no trace of the annulations of the test can be discerned on the internal mold. In the adoral third of the holotype, the camerae average about 8.5 mm. in length. The sutures of this specimen are somewhat sinuous, presumably as a result of distortion during preservation, and it is believed that originally they were essentially straight and directly transverse. At the adoral end of the holotype, the siphuncle is about 27 mm. wide and 24.5 mm. high, and it is located about 1 mm. from the ventral wall of the conch.

Most of the numerous specimens that we are referring to this species are considerably larger than the holotype. The largest of them (Pl. II, fig. 1) is about 750 mm. long and it is septate throughout and is not complete adapically or adorally. The large specimen represented by figure 2 on Plate IV is crushed, but at a transverse break near its mid-length the width of its conch measures about 200 mm. and that of its siphuncle about 97 mm. The specimen represented by figure 2 on Plate III seems to be part of a large conch of the same general magnitude as the two mentioned last, and it shows that the test of large specimens is annulated as is that of the holotype. The annulations on this large specimen are somewhat irregularly spaced, but on the average they are about 7 mm. apart and they rise some 2 mm. above the bottoms of the adjacent troughs. These annulations appear to be directly transverse to the long axis of the conch

and to be very slightly sinuous—their sinuosity may, however, be a result of distortion.

The extreme adapical part of the specimen represented by figure 3 on Plate I is a spiculum; that is, this portion of the specimen is an internal mold of the adoral endocone in the siphuncle. Only the adoral 35 mm. of the spiculum are retained, but it appears to be contracted apicad very gradually and therefore to have been long and slender.

Remarks: At least part of the Minnesota specimens that Clarke figured in 1897 as *Cameroceras proteiforme* probably belong in this species. However, Clarke regarded as conspecific some "fragments" from Decorah, Iowa, and although we have not seen them, we are inclined to believe that they are specifically distinct. Possibly, they represent *Endoceras decorahense*.

One of the most distinctive characters of this species seems to be the annulated surface of its test, which, to say the least, is unusual and presumably differentiates it from such similar forms as *Endoceras decorahense*, described below. There is no good reason to believe that *Endoceras proteiforme* ever attained the gigantic proportions achieved by mature representatives of this species. *E. hennepini*, which occurs in the same general area in Minnesota, has a subcentral rather than a marginal siphuncle.

Occurrence: The holotype of this species came from the Dubuque limestone near Walcott, Rice County, Minnesota. All of the paratypes are from the same formation in sec. 28, T. 108 N., R. 20 W., south of Clinton Falls, Steele County, Minnesota. Clarke states that the "majority" of the specimens that he referred to *Cameroceras proteiforme* came from Cannon Falls, Goodhue County, Minnesota, where the Prosser, Decorah, and Platteville are exposed; insofar as can be told from the published illustrations, at least superficially these Cannon Falls specimens seem to resemble those that we have under consideration, but without seeing them we hesitate to express a definite opinion in regard to their specific affinities. The very large siphuncle which Clarke illustrated and described came from Wykoff, Fillmore County, Minnesota, where the Maquoketa, Dubuque, Stewartville, Prosser, Decorah, and Platteville outcrop; it is of course not possible to determine with certainty the relationship between this siphuncle and the specimens we are studying.

Types: Carnegie Museum, 7651, 7652, 7653, 7654, 7656 and 7657 (holotype and 24 paratypes).

Endoceras gracillimum, sp. nov.

(Plate III, figure 1)

This species is being based on a single internal mold of a phragmacone, which is about 670 mm. long but is not complete adorally or adapically. The cross section of this specimen is broadly elliptical due to dorsoventral depression, at least part of which is not original. It is expanded orad very gradually, and its width increases from about 90 mm. near its adapical end to about 125 mm. near its adoral end. The angle between its lateral zones measures only about 3 degrees.

No trace of surface markings is discernible on this holotype, which is marked only by the sutures. These have been somewhat distorted, but apparently they were essentially straight and directly transverse. The camerae are rather short. In the adapical and central portions of the specimen under consideration they average about 20 mm. in length. In the adoral portion of the same specimen they become considerably shorter, and the length of the adoral five camerae averages only about 14 mm. No trace of the siphuncle is preserved in the only known representative of the species.

Remarks: The above-described specimen is rather poorly preserved to serve as a holotype, and since its siphuncle is not preserved it cannot be oriented satisfactorily. However, it differs markedly from the comparable forms with which it is associated in that it is expanded orad much more gradually, and it does not seem to be referable to any previously described species.

Occurrence: The single known representative of this species came from well up in the Dubuque limestone in sec. 28, T. 108, N., R. 20 W., south of Clinton Falls, Steele County, Minnesota.

Holotype: Carnegie Museum, 7655.

Endoceras decorahense, sp. nov.

(Plate IV, figure 1)

Two portions of the internal mold of a large phragmacone serve as a basis for this species. The larger is about 625 mm. long, and the length of the smaller measures about 320 mm. The interval between the two pieces is estimated to have been some 115 mm., so the total length of the portion of the phragmacone represented by the holotype was some 1060 mm. The specimen is not complete adapically or adorally. However, its adoral camerae are considerably shorter than the preceding ones, which

indicates that it is a mature individual and that the adoral end of the specimen represents essentially the adoral end of the phragmacone. The lateral zones of the holotype converge apicad rather gradually, and the angle between them measures only about $5\frac{1}{2}$ degrees. If this pleural angle was constant throughout the length of the conch, the phragmacone must have been some 2500 mm. (or 8 feet) long. No data are available in regard to the length of the living chamber, and therefore the total length of the conch cannot be estimated.

The dorsal portion of the conch is not preserved, but the holotype is depressed dorsoventrally, probably in part, at least, as a result of distortion during preservation. At the adapical end of the specimen the conch is about 130 mm. wide, and its corresponding height is estimated to be about 125 mm. The maximum width, which is attained at the adoral end of this specimen, is about 230 mm.

The surface of the holotype, an internal mold, is devoid of markings other than the sutures. These are somewhat irregular, presumably due to a slight amount of distortion that the specimen appears to have undergone, but originally they seem to have been essentially straight and directly transverse. The camerae are rather short. Their length averages about 11 mm. in the adapical part of the holotype, reaches a maximum of some 14 mm. in the adapical portion of the larger piece of the specimen, and measures only about 7 mm. in the extreme adoral part of it.

The siphuncle is large and is ventral and marginal in position. Like the conch, it is somewhat depressed dorsoventrally, which may, of course, be a result of distortion. At the adapical end of the holotype, the siphuncle is about 55 mm. wide and about 43 mm. high. At a transverse break near the mid-length of the adoral piece of the holotype, where the conch is about 210 mm. wide, the width and height of the siphuncle measure about 95 mm. and 80 mm., respectively.

Remarks: The above-described holotype is the most nearly complete of the large straight Ordovician cephalopods available to us. The more distinctive characters of the species are the large, rather gradually expanded conch, short camerae, essentially straight transverse sutures, and large marginal siphuncle. So little precise information is available in regard to comparable forms described in this report and elsewhere, that detailed comparisons are not possible.

Occurrence: Decorah formation north of Decorah, Winneshiek County, Iowa—Winneshiek County is just south of the Iowa-Minnesota boundary.

Holotype: State University of Iowa, 2,143.

ADDENDUM

The Chicago Natural History Museum has on display a large endoceratoid, numbered P 17148, from the "Trenton" [Pecatonica member of the Platteville] limestone near Troy Grove, La Salle County, Illinois. This specimen is not complete adorally or adapically and it is slightly crushed. The preserved portion of it is some six feet long and within that length its diameter increases from some four inches to some eight inches. With the possible exception of its adoral four or five inches, this specimen is septate throughout, and the length of the camerae increases adorally. The surface of the test bears low annulations but the internal mold is almost smooth. At least in the adoral part of this specimen, the annulations are not as far apart as are the septa.

REFERENCES

- BASSLER, R. S.
1915. *Bibliographic index of American Ordovician and Silurian fossils*: U. S. Nat. Mus. Bull. 92, pp. 1-1521 (in two volumes), pls. 1-4.
- CLARKE, J. M.
1897. *The Lower Silurian Cephalopoda of Minnesota*: Minnesota Geol. and Nat. Hist. Survey, vol. 3, pt. 2, pp. 761-812, pls. 47-60.
- FOERSTE, AUG. F.
1924. *Notes on American Paleozoic cephalopods*: Denison Univ. Bull., Jour. Sci. Labs., vol. 20, pp. 193-267, pl. 21-42.
1925. *Notes on cephalopod genera; chiefly coiled Silurian forms*: Denison Univ. Bull. Jour. Sci. Labs., vol. 21, pp. 1-70, pls. 1-24.
1932. *Black River and other cephalopods from Minnesota, Wisconsin, Michigan, and Ontario (Part I)*: Denison Univ. Bull., Jour. Sci. Labs., vol. 27, pp. 47-136, pls. 7-37.
- HALL, JAMES
1847. *Natural history of New York, Palaeontology, vol. 1, containing descriptions of the organic remains of the lower division of the New-York system, (equivalent of the Lower Silurian rocks of Europe)* [issued by New York Geol. Survey], pp. 1-338, pls. 1-33.
- HARRINGTON, M. W.
1876. *Steele County*: Minnesota Geol. and Nat. Hist. Survey Ann. Rept. 4, pp. 107-114.
- HYATT, ALPHEUS
1900. *Cephalopoda*: in Zittel-Eastman *Text-book of palaeontology*, vol. 1 ed. 1, London, pp. 502-604.
- KAY, G. MARSHALL
1935. *Ordovician Stewartville-Dubuque problems*: Jour. Geol. vol. 43, pp. 561-590.

KOBAYASHI, TEIICHI

1936. *Classification of primitive cephalopods*: Chikyū, the Globe, vol. 25, pp. 11-27, 85-105, 180-192, 271-281, 331-353. [Abstract in Japanese Jour. Geol. and Geog., vol. 13, nos. 3-4, pp. A34-35.]

MILLER, A. K.

1932. *The cephalopods of the Bighorn formation of the Wind River Mountains of Wyoming*: Connecticut Acad. Arts and Sci. Trans., vol. 31, pp. 193-297, pls. 1-31.

STAUFFER, C. R., AND THIEL, G. A.

1941. *The Paleozoic and related rocks of southeastern Minnesota*: Minnesota Geol. Survey Bull. 29, pp. 1-261.

TEICHERT, CURT

1930. *Die Cephalopoden-Fauna der Lyckholm-Stufe des Ostbaltikums*: Palaeont. Zeitschtr., Bd. 12, pp. 264-312, pls. 5-9.

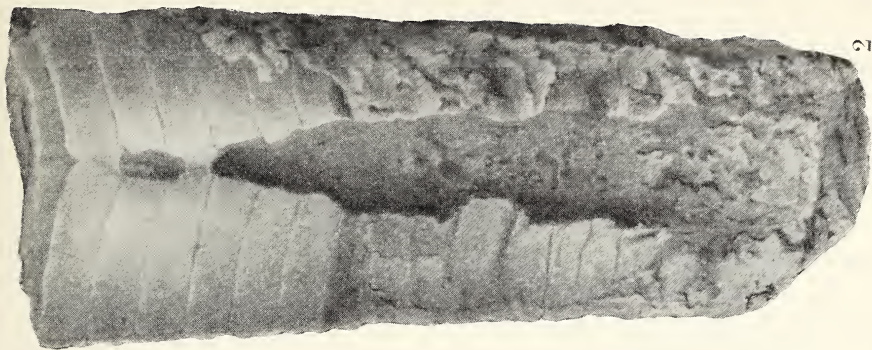
WOODWARD, S. P.

1856. *On an Orthoceras from China*: Quart. Jour. Geol. Soc., vol. 12, pp. 378-381, pl. 6.

EXPLANATION OF PLATE I

FIGS. 1-3. *Endoceras clarkei*, sp. nov.

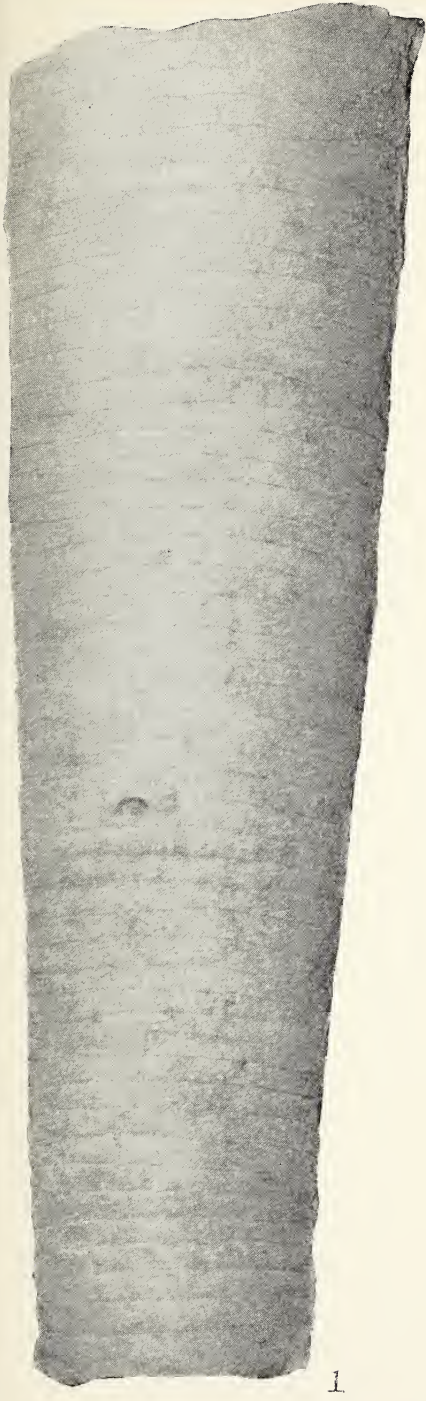
Two views of the holotype (figs. 1, 2—C. M. 7653) and one view of a paratype (fig. 3—C. M. 7654), all $\times \frac{2}{3}$. Both specimens are from the Dubuque formation of southeastern Minnesota—the holotype is from near Walcott and the paratype from south of Clinton Falls.



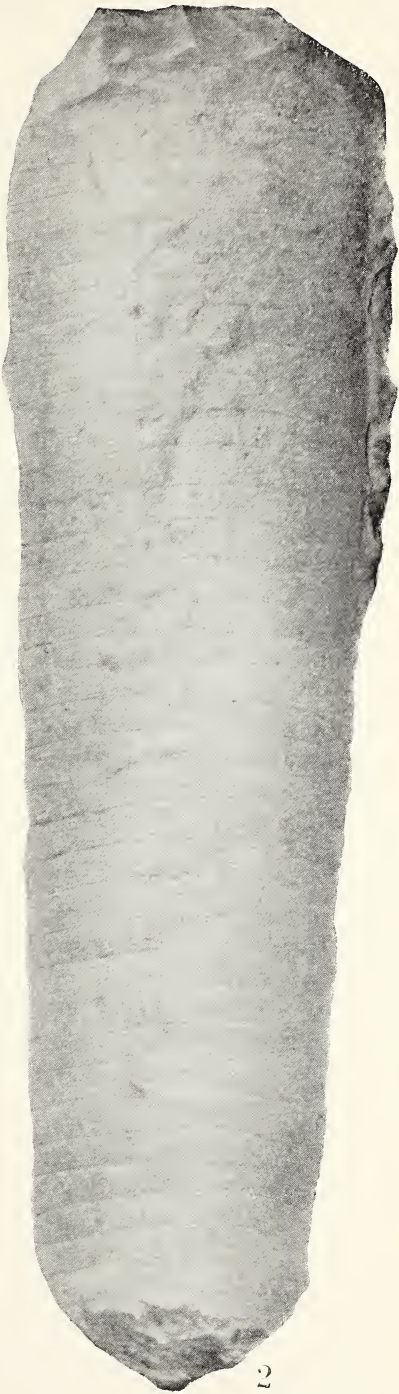
EXPLANATION OF PLATE II

FIGS. 1, 2. *Endoceras clarkei*, sp. nov.

Two large paratypes, x $\frac{3}{4}$, from the Dubuque formation south of Clinton Falls, Minnesota (C. M. 7651, 7652).



1



2

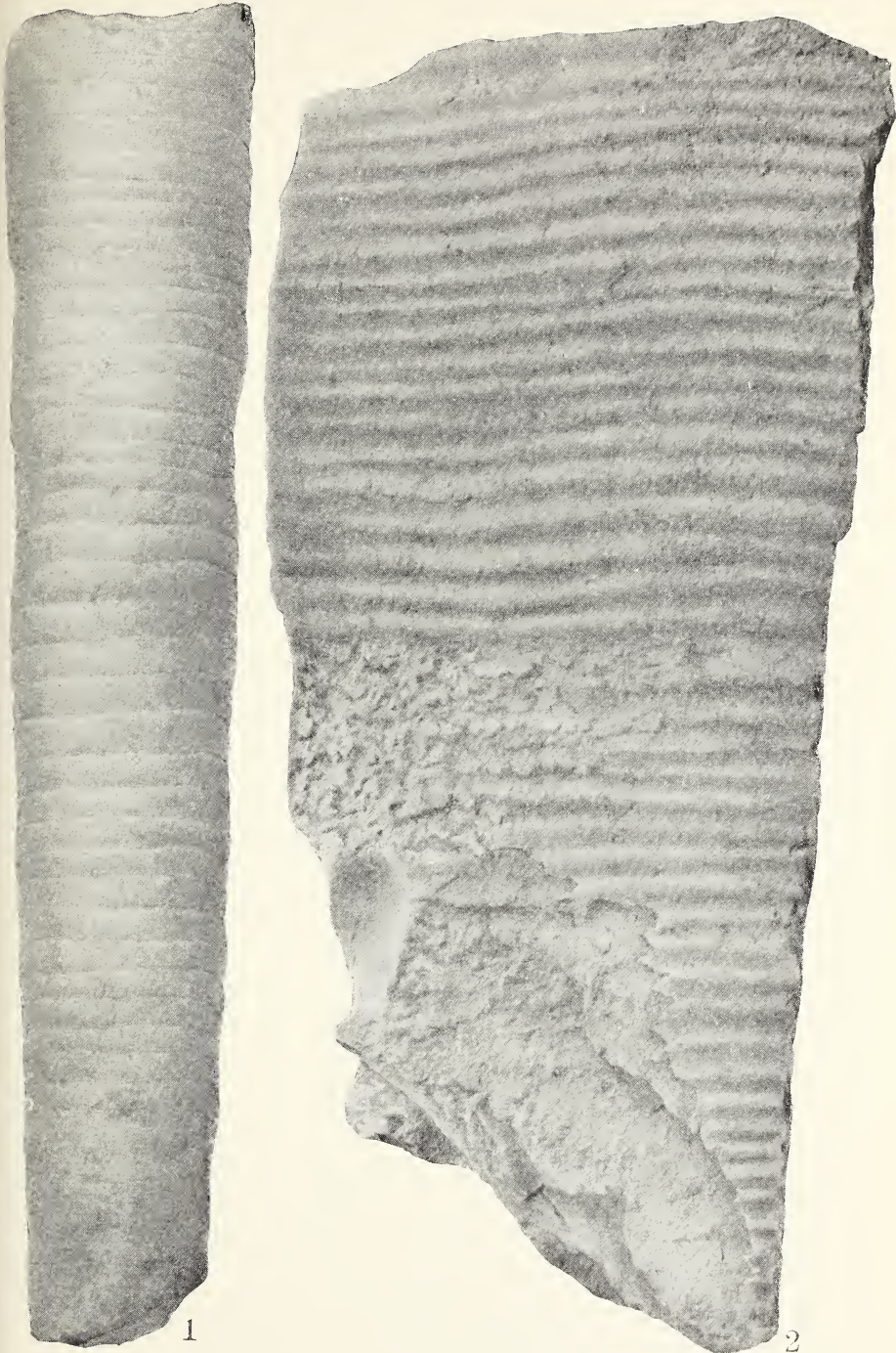
EXPLANATION OF PLATE III

- FIG. 1. *Endoceras gracillimum*, sp. nov.

The holotype, $\times \frac{1}{4}$, from the Dubuque formation south of Clinton Falls, Minnesota (C. M. 7655).

- FIG. 2. *Endoceras clarkei*, sp. nov.

A paratype, $\times \frac{3}{8}$, from the same horizon and locality as the preceding (C. M. 7656).



EXPLANATION OF PLATE IV

FIG. 1. *Endoceras decorahense*, sp. nov.

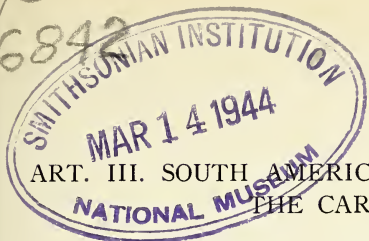
The holotype, $\times \frac{1}{6}$, from the Decorah formation north of Decorah, Iowa (S. U. I. 2,143).

FIG. 2. *Endoceras clarkei*, sp. nov.

A paratype, $\times \frac{2}{5}$, from the Dubuque formation south of Clinton Falls, Minnesota (C. M. 7657).



173
P6842

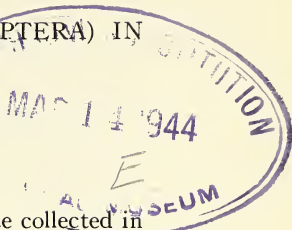


ART. III. SOUTH AMERICAN ARADIDAE (HEMIPTERA) IN
THE CARNEGIE MUSEUM

By C. J. DRAKE AND H. M. HARRIS

IOWA STATE COLLEGE

AMES, IOWA



The present paper is based almost entirely upon Aradidae collected in South America by H. H. Smith and belonging to the Carnegie Museum. The collection contains many interesting species, adds a number of new distributional records, and includes an undescribed apterous species from Brazil. The types of the new species are in the Carnegie Museum. The writers are indebted to the director, Dr. A. Avinoff, for the privilege of studying the specimens.

Aradus falleni Stal

Aradus falleni Stal, Rio Jan., Hemip. I, 1860, p. 68; Champion, Biol. Centr.-Amer., Rhyng. II, 1898, p. 66, pl. 5, fig. 1.

Chapada, Brazil; four specimens. This species is very widely distributed in South, Central, and North America. Closely allied species are *A. angustatus* Blanchard (Brazil, Argentina, and Chile), *A. brasiliensis* Usinger (Brazil and Bolivia), *A. penningtoni* Drake (Brazil and Bolivia), *A. snowi* Van Duzee (southern United States), and the species below. The species of this group of the genus *Aradus* are strong fliers and are frequently taken singly or in flight.

Aradus mexicanus Usinger

Aradus mexicanus Usinger, Ann. Ent. Soc. Amer., XXIX, 1936, p. 503.

Chapada, Brazil; three specimens. Specimens of this interesting species are also at hand from Mexico.

Phyllotingis interjecta (Bergroth)

Phyllocraspedum interjectum Bergroth, Ent. Tidskr., XV, 1894, p. 98, fig.

Phyllotingis interjecta Champion, Biol. Centr.-Amer., Rhyng., II, 1898, p. 68, pl. V, fig. 3.

Santarem, Brazil; male and female. Known also from Colombia and Panama. Champion (*loc. cit.*) corrected Walker's error and transferred the genus *Phyllotingis* from the family Tingitidae to the Aradidae. Very little is known about the habits of the species of this genus; all are South American.

MAR 14 1944

Atashugh. Carnegie Museum
Carnegie
V. 3, p. 3

Proxius gypsatus Bergroth

Proxius gypsatus Bergroth, Ent. Monthly Mag. XXXIV, p. 100; Champion, Biol. Centr.-Amer., Rhyng., II, 1898, p. 70, pl. 5, figs. 8-9.

Para and Chapada, Brazil; five specimens. This peculiar species is recorded in the literature from Venezuela, Panama, and Guatemala.

Hesus cordatus (Fabricius)

Aradus cordatus Fabricius, Syst. Rhyng., 1803, p. 117.

Hesus cordatus Stal, Hemip. Fabr. 1, 1868, p. 95; Champion, Biol. Centr.-Amer., Rhyng. II, 1898, p. 73, pl. 5, fig. 12.

Hesus annuliger Stal, Stett. Ent. Zeit., 1862, p. 438; Enum. Hemip. III, 1873, p. 142.

Crimia cincticornis Walker, Cat. Hemip. Heter., VII, 1873, p. 11.

Hesus simiolus Bergroth, Ent. Tidskr. XV, 1894, p. 102.

Para, Chapada, Santarem, Brazil, many specimens; Don Amo, Colombia, one specimen. Extends from Mexico south into Brazil.

Hesus acuminatus (Fabricius)

Aradus acuminatus Fabricius, Syst. Rhyng., 1803, p. 117.

Hesus acuminatus Stal, Hemip. Fabr., 1, 1868, p. 95.

Para, Brazil; three specimens. Mana River, French Guiana, May, 1917; three specimens. Ranges from Mexico south into Brazil.

Hesus flaviventris (Burmeister)

Dysodius flaviventris Burmeister, Handbuch., II, 1835, p. 255; Herrich-Schaeffer, Wanz. Ins., IX, 1853, p. 140, pl. 312, fig. 957.

Hesus flaviventris Stal, Enum. Hemip., III, 1873, p. 142.

Para, Santarem, Chapada, Brazil; ten examples also recorded from Panama and Colombia.

Var. *subarmatus* Stal: Villa Bridge, Chapada, Obidos, Brazil, five specimens; R. Japacani, Eastern Bolivia, one specimen collected by J. Steinbach. Also known from British Honduras, Guatemala, Panama, and French Guiana.

Artagerus hispidus Champion

Artagerus hispidus Champion, Biol. Centr.-Amer., Rhyng. II, 1898, p. 77.

Para, Brazil; two specimens. June. Described from Panama.

Artagerus histricus Stal

Artagerus histricus Stal, Stett. Ent. Zeit., XXIII, 438, 1862.

Santarem, Brazil; one specimen, Nov. Recorded in the literature from Mexico.

Artagerus crispatus Stal

Artagerus crispatus Stal, Rio Jan. Hemip., I, p. 67, 1861.

Santarem and Para, Brazil; three specimens. Also known from Panama.

Aphleboderrhis pubescens (Walker)

Aradus pubescens Walker, Cat. Hemip. Heter., VII, 1873, p. 38.

Aphleboderrhis pubescens Champion, Biol. Centr.-Amer., Rhyng. II, 1898, p. 79, pl. V, fig. 26-27.

Chapada and Santarem, Brazil; ten specimens. Recorded in the literature also from Mexico, Guatemala, and Panama.

Aphleboderrhis comata Champion

Aphleboderrhis comata Champion, Biol. Centr.-Amer., Rhyng. II, 1898, p. 79, pl. V, fig. 24-25.

Santarem, Para, and Chapada, Brazil, April, three specimens; Argentina. Panama is the type locality.

Apheleboderrhis pilosa Stal

Apheleboderrhis pilosa Stal, Rio Jan. Hemip. I, p. 67, 1861.

Rio de Janeiro, Brazil, October; three specimens.

Dysodius lunatus (Fabricius)

La Punaise araignee Stoll, Punaisses, 1788, p. 53, pl. 13, fig. 84.

Acanthia lunata Fabricius, Ent., Syst., IV, 1794, p. 72.

Dysodius lunatus Champion, Biol. Centr.-Amer. Rhyng. II, 1898, p. 86, pl. VI, fig. 9.

Para, Sao Paulo, Chapada, and Santarem, Brazil, many specimens; Horqueta, Paraguay, many examples; St. Benedict Mt., Tunpuna, Trinidad, W.I., one specimen, M. G. Netting. This insect is widely distributed in Mexico, Central America, and the West Indies, and is also known from Colombia and Venezuela in South America. It is very variable in size and is frequently taken in numbers.

Dysodius crenulatus Stal

Dysodius crenulatus Stal, Stett. Ent. Zeit., 1862, p. 437; Champion, Biol. Centr.-Amer., Rhyng., II, 1898, p. 87, pl. VI, figs. 10, 10a.

Potrerillos, Panama, May, 1935, three examples; Don Amo, Colombia, five specimens. Common and widely distributed in Central America and extends south into Colombia and Venezuela.

Dysodius brevipes Bergroth

Dysodius brevipes Bergroth, Wien. Ent. Zeit., XVII, 1898, p. 26.

Guanocosta, Costa Rica, June, 1903, one female. The types were collected in Mexico.

Dysodius ampliventris Bergroth

Dysodius ampliventris Bergroth, Ent. Tidskr. XV, 1894, p. 103; Champion, Biol. Centr.-Amer., Rhyng. VI, 1898, p. 88, pl. VI, fig. 14.

Don Amo, Colombia, one specimen; Santarem, Brazil, one specimen. Not common in collections and known only from the two countries mentioned.

Lobocara ovata Bergroth

Lobocara ovata Bergroth, Rev. d'Ent., XI, 1892, p. 260; Champion, Biol. Centr.-Amer., Hemip. II, 1898, p. 91, pl. 6, fig. 22.

Santarem, Brazil; one specimen. This record greatly extends its range. Heretofore known from Mexico, British Honduras, Guatemala, and Nicaragua.

Mezira granuliger (Stal)

Brachyrhynchus granuliger Stal, Rio Jan. Hemip., I, 66, 1860; Enum. Hemip. 1873, 3:145.

Three specimens, Chapada, Brazil; September.

Mezira handlirschi (Bergroth)

Brachyrhynchus handlirschi Bergroth, Bull. Mus. Paris, 1898, no. 3, p. 150; Champion, Biol. Centr.-Amer., Rhyng. II, p. 95, pl. VI, fig. 27.

Three specimens, Santarem, Brazil, and two specimens, Para, Brazil.

Melanosterphus spinosus (Fabricius)

Aradus spinosus Fabricius, Syst. Rhyng., 1803, p. 119.

Melanosterphus spinosus Stal, Hemip. Fabr., I, 1858, p. 97; Stal, Enum. Hemip. III, 1873, p. 146.

Para, Chapada, and Santarem, Brazil; five specimens. This striking species is very rare in collections. The high, erect, prominent protuberances on the pronotum and the two long, lateral, spine-like projections (one in front and the other behind the eye) on each side of the head are distinguishing structures. The head is bifid in front.

Notoplocoris monteí Usinger

Notoplocoris monteí Usinger, Pan-Pacific Ent., XVII, no. 4, 1941, p. 172, fig. 7.

Male, Rio de Janeiro, Brazil, October. This is the second record of this striking species from Brazil, the type country. The specimen agrees very closely with the original description and illustration of Usinger.

Notoplocoris potensis, sp. nov.

Male: Somewhat triangular in form, brownish black, irregularly clothed with suberect or erect, brownish hairs. Head with apical processes moderately long, slightly divergent apically, longer than width through eyes (65:52), strongly obliquely-narrowed posteriorly behind eyes; eyes rather large, prominent, projecting, grayish brown; antenniferous tubercles large, conical, thick at base, divergent. Antennae moderately long, beset with numerous long, coarse, brown hairs; segment I long, much stouter than others, slightly curved and much narrower at base; II slender, straight; III slightly slenderer; IV short, subclavate, clothed with short, fine, brown hairs at apex; proportions I, 42; II, 26; III, 38; IV, missing. Rostrum not reaching base of head.

Pronotum distinctly wider than long, the meso- metanotum distinctly progressively wider, the sides strongly lobulate, the pronotum above with a prominent protuberance on each side of the sunken median line. Wing pads absent. Metasternal channel orifice distinct. Abdomen gradually widening posteriorly, the last segments expanded and bilobate laterally; connexivum gradually widening posteriorly. Legs rather short, granulate, with thick, brownish hairs. Male genital segments rather large, rounded, the penultimate above with two thick, tooth-like protuberances, these not evident when segment is retracted.

Female: Distinctly larger than male, the dorsal protuberance on pronotum and the lateral lobes on last abdominal segment smaller. Antennal proportions, 43:28:40:20; segment IV enlarged on distal half.

Measurements: Male, length, 12.20 mm.; width, 5.25 mm.; female, length, 15.50 mm.; width, 6.20 mm.

Type: (Male) and allotype (female), in the Carnegie Museum, Rio de Janeiro, Brazil, November, collected by H. H. Smith.

This species may be separated from *N. monteí* Usinger by the hairy antennae (all segments), prominent pronotal tubercles, longer pronotum, and the large, rounded lateral lobes of the last abdominal segment. It is also a little larger. Only two species, both from Brazil, are known in this genus.

507.73
.P4P6842

**ART. IV. AFFINITIES OF PHOEBIS RORATA COMSTOCKI,
A NEW PIERID BUTTERFLY FROM JAMAICA**



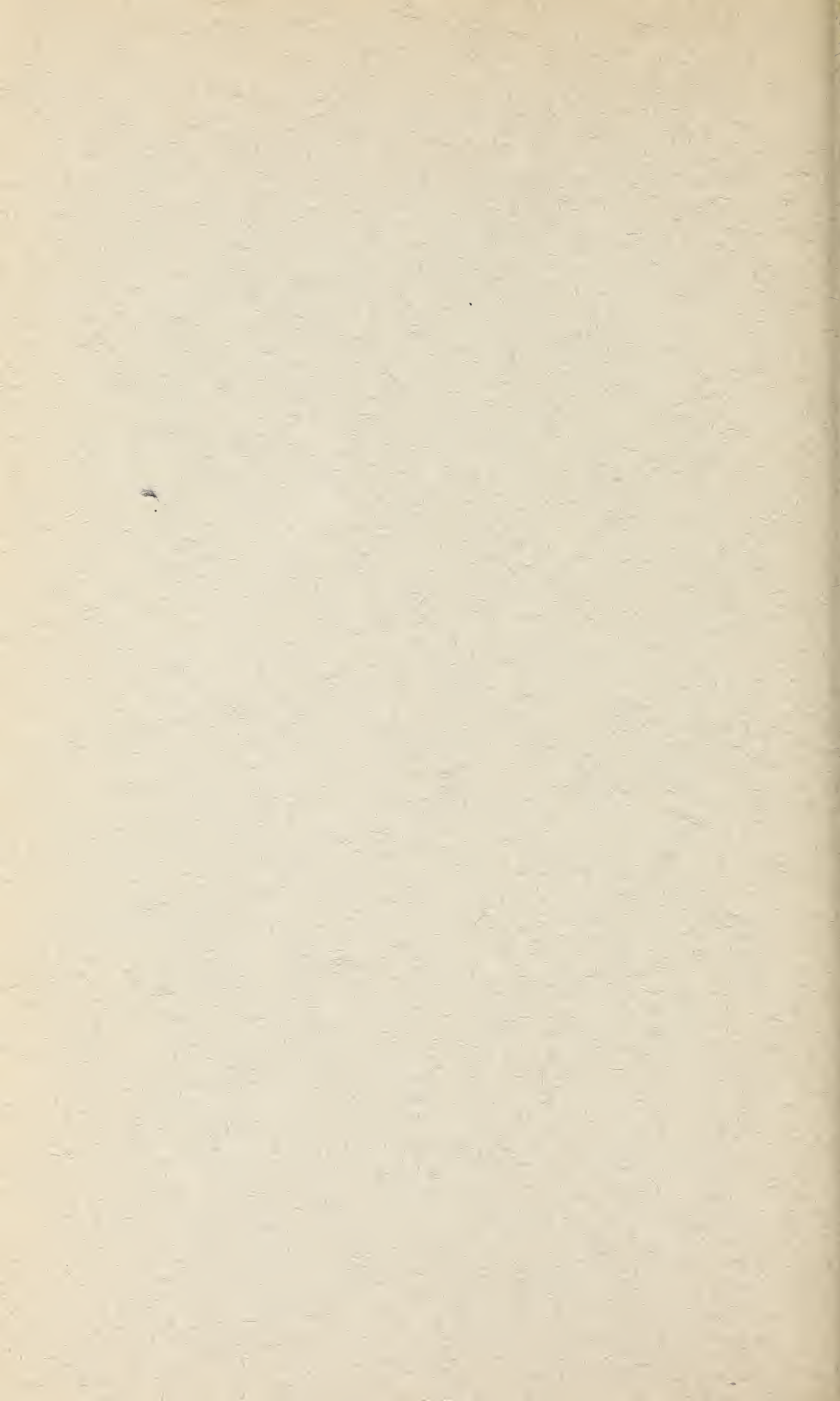
BY A. AVINOFF

Annals of the Carnegie Museum

Vol. XXX. p. 45-56, 1944

Issued May 11, 1944

Pittsburgh, Pa.



ART. IV. AFFINITIES OF *PHOEBIS RORATA COMSTOCKI*,
A NEW PIERID BUTTERFLY FROM JAMAICA

By A. AVINOFF

(PLATES I-III)

In the course of my studies of the lepidopterous fauna of Jamaica, British West Indies, I found that the local representative of *Phoebis argante* Hbn. requires a special description. The whole problem of the status of *Phoebis argante* is not completely clear. As far as the generic name is concerned, Mr. Martin Brown, who recently monographed the genus, is quite correct in using the term *Phoebis* for which in 1873 Butler designated as type the species *argante*. In this group of American Pierids the name of *Callidryas*, or *Catopsilia*, should be dropped, the latter being ascribable only to the cycle of related forms of the Old World. The generic name of *Aphrissa*, suggested by Butler for *statira* Cr. and its relatives, might be reserved for another cycle of Pierids of the New World which also appear in literature under the misused designations of *Callidryas* and *Catopsilia*, although the validity is questionable. It is not the intention of this paper to go thoroughly into all questions associated with *Phoebis argante* and its immediate relatives; the purpose being chiefly the correct identification of the Jamaican butterfly which appears in literature under this name. It seems desirable for clarity of exposition to survey a few salient facts concerning the distribution of forms belonging to this group, which has been so frequently misunderstood and misinterpreted.

Some entomologists like W. J. Kaye were misled so far as to consider *argante* conspecific with *agarithe* Bsd. Röber in Seitz' "Macrolepidoptera of the World" is also not inclined to recognize a specific distinction between the two. The reverse of the front wings indicates very clearly the obvious independence of the two species. The transverse series of maculae running from the apex to the inner border form a straight line in *agarithe* and show a broken arrangement in steps in the group of *argante*. The shrewdest of all lepidopterists on this subject, Butler, was quite correct in recognizing several related species within the cycle of *argante*. The differentiations which he has indicated in his "Lepidoptera Exotica" are well supported by distributional facts. The true *argante* in the male has a series of marginal black points at the end of the veins, as it is represented

in Hübner (Samm. Ex. Sch., I, Pl. 145, figs. 1, 2, 1806), in Lucas (Hist. Cuba Articulata, Pl. 15, figs. 4, 4a, 1856) and in Butler (Lep. Exot., 1874, Pl. 44, figs. 1-4).

The female is of the same bright orange color as the male, with a relatively unaccentuated black pattern along the margins of both wings and the discocellular of the primaries. The locality is indicated by Butler as "Brazil, Panama, and Honduras."

In the Carnegie Museum collection, typical *argante* with an orange yellow female is represented from Venezuela. To the same form should be assigned the variety with the bright yellow female, showing the orange tinge characteristic of the male and of the true *argante* female. The form *hersilia* Cr., which may be a separate species, has the same orange yellow female as *argante*, but has a more strongly developed black pattern which is especially prominent in the rich maculation of the underside. The male differs from *argante* in having the continuous black margin of the front wings and by the strong development of the pattern on the reverse. Butler indicates that the presence of two silvery spots on the reverse of the hind wings is a characteristic of *hersilia* as compared with *argante*. This cannot be taken as a completely diacritical mark since true *argante* males, with the marginal character reduced to a neural row of spots, may occasionally show a colored silvery pupillation of the mesial spot. The distribution of *hersilia* coincides with *argante* since it is found in Brazil, Cayenne, Peruvian Amazon, Nicaragua, and Ecuador. The Carnegie Museum has it from Peru, Brazil, and Bolivia. In the latter region both *argante* and *hersilia* occur in the same localities, a fact which leads some entomologists to accept them as morphs of the same species. According to Butler the female may vary from golden yellow to white with a slight rosy tinge. In the yellow-orange forms the difference between *argante* and *hersilia* seems to depend on the heaviness of the black pattern which is a characteristic variable within certain limits. It is probably impossible to establish an entirely fast dividing-line unless one has a series of males to be associated with such specimens, while females with a slight yellow flush on the margin of the hind wings could be ascribed to *hersilia* with certain reservations.

Catopsilia minuscula Butler (figured on Pl. 44, figs. 9, 10) is apparently a dwarfed specimen of the true *argante*, or one of its geographical forms, since size is the only characteristic of this diminutive form. It is a known fact that Pierids, more frequently than any other group of butterflies, at times produce underfed dwarfed specimens which may reach only half

the expansion of the normal type. The genus *Terias* is especially noted for such a propensity.

Catopsilia fornax, described by Butler from the female alone from a locality marked "Chile," probably an alleged or uncertain locality, is bright yellow with an intense red tinge on the hind wings and a rather heavy exterior suffusion of red scales on the front wings.

From the Isle of Pines a series was obtained by the collector of the Carnegie Museum which corresponds exactly with such females in Butler's "Lepidoptera Exotica," Pl. 39, figs. 5, 6. The male which was collected simultaneously with these females is of an *argante* type with mere black dots on the edge of the front wings. It is apparently a form close to the true *argante* and is characterized by the heavy red suffusion of the female.

The citation of Chile as the type locality of *fornax*, Coll. Kaden in Coll. Druce, is apparently wrong since a similar origin and the reference to the same Coll. of Kaden is also given for *solstitia* Btlr. There is no doubt that the latter butterfly is scarcely distinguishable from *avellaneda* Sch. Whatever might be the systematic status of *solstitia*, it is nothing but a form or a mere synonym of that Cuban butterfly. Thus there is scarcely any doubt that *fornax* also was originally obtained from Cuba. This contention is corroborated by a note of Bates, "Butterflies of Cuba," page 135, which mentions that Cornell University possesses a female of an insect almost exactly like Butler's figure of *fornax*, labelled "Cuba." This reference agrees with the material in the Carnegie Museum which contains three females of a typical *fornax* from the Isle of Pines. The males to be associated with this female are of an *argante* type. In this respect the monographer of this group of butterflies, Martin Brown, is in error in associating *fornax* with *philea*. The divergence of the group *philea* L. and *argante* is quite apparent in the females. The intense orange or Indian-red suffusion on the outer side of the hind wings is even and gradual, while in the forms of *rorata* this coloration is produced by an intensification of separate specks which gradually become confluent toward the border. *C. fornax* has this latter characteristic and on this ground alone should not have been associated with *philea*, as was done by Martin Brown.

The three specimens of *fornax* from Cuba which were very obligingly sent to me for study by the Museum of Comparative Zoölogy in Cambridge, are typical representatives of that form; two are not to be distinguished from the specimens from Nova Geron in the Carnegie Museum, and the third is of a far brighter brick red coloration than any of

the specimens from the Isle of Pines. One should scarcely expect, however, to find sufficient distinction between the main insular form and the representative from the smaller neighboring islands. The white female from the Island of Cuba is another matter. This specimen, preserved in the Museum of Comparative Zoölogy, and mentioned by Martin Brown, is actually a light form of the regular *argante*, and coincides completely with the females of that species from British Guiana. It is characterized by an underdevelopment of the marginal black pattern on the upper side and by a somewhat restricted dark pattern on the hind wings. The finding of a typical *argante* on Cuba is in itself quite unexpected. This solitary specimen bearing the label "Cuba, Wright" should be substantiated by other material since the attribution of the typical *argante* to the island hinges so far exclusively on this individual. If these distributional facts are valid it seems to prove that *argante* and *fornax* are two specific entities. The name *adela* of Martin Brown could not be given to the light specimen from Cuba since it is referable to the typical yellow female of the regular *rorata* Butler (the insular representative of *argante*). This, in itself, is a somewhat confusing statement in two points: it is not clear whether the specimen which Mr. Brown described is identical with the yellow forms of *argante* as found in Guatemala, or on which island of the West Indies this particular yellow female was found. The female from the island of Cuba in question certainly could scarcely be called yellow, although it possesses to a certain degree a yellowish tinge on its ground color. It fits much better among the whitish forms of the female of *argante* which Mr. Martin Brown designated under the name of *albante* without any indication as to the origin of the type. Even if *adela* is not a *nomen nudum*, it appears to be scarcely other than a synonym of *fornax*, as far as one can judge from a specimen of a female bearing a label in the writing of Mr. Brown, "*Phoebus argante rorata* f. *adela*," which is just a regular *fornax*. This individual, collected by Schaus and Barnes at Matanzas, Cuba, is preserved at the American Museum and was obligingly lent for study. Furthermore it is also not clear whether *albante* is suggested for the occasional white morphs of the female to be encountered among the tinted individuals, or whether such white females are a regional characteristic and constitute racial distinctions. The case of white females in the genus *Colias* indicates a wide range of variation in the taxonomic status of similar white females. In a number of examples of *Colias* with orange males, there may occur either exclusively orange females without a single known white form or an even proportion between

white and orange types, or else white females predominating to the almost complete exclusion of the orange ones; the ratio of the white females varying geographically. In this regard the examples of *Colias fieldi* Mén., *edusa* F., *myrmidone* Esp., *thysoa* Mén., *chrysotheme* Esp., *eogene* Feld., *aurora* Esp., and *diva* Gr. Gr., are very instructive. It may be that a more thorough study of the *Phoebis* of Central and South America, and of *argante* in particular, will furnish new data on the meaning and frequency of the white females, from the point of view of regional and taxonomic significance.

According to Brown and Barnes, *argante* and *hersilia* are the continental forms while *rorata* constitutes the insular representation in the Greater Antilles, having been originally described and figured from Haiti. *P. fornax* belongs apparently to the cycle of *rorata*. The butterfly from Jamaica belongs distinctly to that insular division of the *argante* complex. While males were recorded a long time ago, they did not give positive evidence of the systematic position of this form. Fortunately the capture of the female showed conclusively that this butterfly is a close relative of the Haitian *rorata*.

The form of *rorata* from Jamaica requires a special designation. The females are far more characteristic than the males which Kaye has obtained on this island. They were not only erroneously identified by him as *argante*, but he furthermore stated that *agarithe* is a dry season form of *argante* although according to his information it is to be taken in Jamaica in the wet season as well as in the dry!

***Phoebis rorata comstocki*, subsp. nov.**

Male: Bright orange-yellow with black marginal spots at the extremities of the veins. The marginal androconia are slightly lighter at a certain angle of illumination than the light orange color of the wings. The apex has a narrow black margin. The reverse is golden-yellow speckled with reddish brown with the usual marks of the *argante* group. The two red central maculae of the hind wings have a small center of mother-of-pearl scales or of pale pinkish scales without the mother-of-pearl lustre.

Female: Light straw-yellow with well defined marginal spots at the end of the veins of both wings, a black apex with an extension inwardly of a band with spots receding outwardly at the third radial vein. There are two costal black fuscous spots at the discocellular divided by the light straw-yellow vein. Both wings have an irroration of Indian-red speckles

which on the hind wings grow denser toward the outside and are slightly indicated at the base. On the front wings the irroration of Indian-red speckles is very slight, reduced to the area of the discocellular and the region toward the dark apex. The discus of the wing and the marginal portion show but very few reddish specks. The reverse is of a golden yellow color with brownish red, or a vinaceous pattern which is constituted by an interrupted band on the front wings from the apex toward the inner margin and is continued on the hind wings in a widening band through the mesian area containing the two usual silvery spots. The front wings have a large irregular discocellular patch with a lighter center of silvery scales. There is a general reticulation of the vinaceous dots and vermiculated lines with a certain intensification on the marginal ends of the veins and in the area of an irregular broken up band of the front wings and on the hind wings between the margin and the discal dark band. This race is named *comstocki* after W. P. Comstock of the American Museum of Natural History, New York City, noted for his studies of West Indian lepidoptera. The typical series comes from the vicinity of Bath (Hamp-ton Court and Balcarres) in the eastern part of Jamaica. Specimens were collected by A. Avinoff and N. Shoumatoff in the month of July on several occasions during their visits to the island between the years 1933 and 1940. The collection contains besides the type and allotype, eight para-types including seven males and one female.



FIGS. 1, 2. Underside of wing of *Phoebis rorata comstocki*, subsp. nov. The right figure (2) is a diagrammatic tracing in dark tone of the iridescent areas only.

This race of *rorata* is very close to the typical *rorata* of Haiti as figured by Butler on Pl. 44, figs. 5-8, of his "Lepidoptera Exotica," and as repre-

sented by characteristic specimens from Haiti in the Carnegie Museum. The differences are shown in the following table:

1. Both sexes of *comstocki* are slightly smaller than the Haitian form.
2. The male of the Jamaican form is slightly less brilliantly orange and tends more toward the golden yellow.
3. The androconia of the marginal part of the wings are still less orange in intensity of coloration, tending slightly toward the golden yellow.
4. The dark margin of the apex is more accentuated; the reverse is less profusely speckled with reddish brown.
5. The female has much less Indian-red irroration on the front wings, the discal part being mostly free from it, whereas in *rorata* this suffusion is quite marked.
6. On the hind wings the irroration of Indian-red is reduced toward the base and altogether not so abundant as in the Haitian form.
7. On the reverse the irroration of purple-brown is considerably reduced in both sexes as compared with the Haitian form and in the female this produces a much more contrasting effect of the bands and of the main pattern of maculations on the yellow ground color.

It is interesting to note that the new race belonging to the *argante* complex is found only in the extreme eastern part of the island while the territories to the west, starting with the vicinity of Spanish Town, are populated by *argante*. It appears, as far as present observations show, that the two habitats do not overlap. It is also of interest to observe that the Cuban region, including the Isle of Pines, is inhabited by a form of the *argante* group which diverges from the true *argante* in the direction of *rorata*, with a certain external likeness to *phileia*. The latter, however, always shows in the female a gradual tinting of the yellow background in the base toward the orange in the exterior part of the hind wings, and does not show any speckled pigmentation of red over yellow as in *forax*. It should also be pointed out that all males of the Jamaican form have well developed silvery spots in the center of the reverse of the hind wings, which is but a rare occasional character in *argante* but a more constant one in *hersilia*. Martin Brown considers *argante* and *rorata* conspecific. He bases this opinion on the impossibility on anatomical grounds of distinguishing the two insects. The armature of both butterflies is practically the same but this point in itself is not sufficient for merging species especially in Pierids. The genus *Colias*, on this basis, should have a great number of its species fused into one systematic unit.

In the light of all these facts, the picture of the distribution of the forms is as follows: the continental forms split into two entities, one with the solid black edge of the forewings of the male in *hersilia*, the other with

this edge reduced to mere black points at the end of the veins in the monotypical *argante*. Whether these two forms are but morphs of a dimorphic species, or constitute a parallel distribution of two independent species, is a matter that cannot be definitely decided at present. In fact, it should be decided by rearing these forms in order to ascertain their identity or distinction. The insular representative of the group is *rorata*. Again, one cannot take a final stand on the specific differentiation of this butterfly as compared with *argante*. Butler, with all his analytical acumen, was tending toward recognizing too many distinct species in the group which was then at large called "*Catopsilia*." Seitz and his collaborators, on the opposite side, took the other extreme stand of "lumping" definite species into a collective unit. I am inclined to separate *rorata* from *argante*, even if there are no apparent anatomical differences. However, the structural distinctions of the distribution of androconia in the male, and the peculiar heaviness of the dark markings and the speckled distribution of the red irroration in the female, are sufficiently definite traits for specific distinction. The vicarious insular species of the continental entity may be called *rorata*, which may be one or two species depending on the taxonomic position of *hersilia* and the true *argante*. The record of an *argante* on Cuba requires further verification. The position of *rorata* is particularly interesting, however, since it indicates a certain leaning toward *philea*, which is an entirely distinct species in every respect, although it shows certain affinities with *rorata* in the pattern of the reverse and the characteristics of the coloration of the female. Another question that arises in this conjunction is the relationship of *philea* and *thalestris*. The Carnegie Museum collections contain examples of both butterflies from Haiti, but whether there exists an actual intergradation as between extreme forms of the same species or an occurrence of two species with an occasional hybridization is again a matter to be tested experimentally through rearing. It is noteworthy, nevertheless, that *thalestris*, as illustrated by Hübner and Butler, is a typical Antillean butterfly, and does not occur with *philea* in its continental habitats.

The Jamaican form of *rorata* acquires an independent and understandable position as an insular choromorph, or race, closely allied but not identical with the typical *rorata* of Haiti, and quite distinct from the Cuban *fornax* which belongs to the periphery of the same cycle.

An imperfect photograph of the reverse of the female has indicated some unusual characteristics of the pattern. This photograph was taken on process films without a filter which apparently, with the same in-

tensity, recorded the golden yellow of the background and of the markings which are thus completely lost in the uniform gray of the print. A new feature however emerged, this being a very faint bluish iridescence in certain parts of the exterior half of the wings. This iridescence covers both the yellow background and the dark markings in the fashion of an independent superimposed pattern emerging very clearly as an antemarginal band which is otherwise not noticed by the eye in the actual specimen. This light band has inwardly none of the broken outline of the dark pattern but runs as an evenly curved light antemarginal band with five small round neural dots which are not seen at all on the insect. On the hind wings appears an antemarginal band composed of a large macula in the upper corner following the dark irregular band which thus appears light and dark instead of being vinaceous brown on the light yellow background. This light line runs to the marginal part along the first radial and a light spot is visible in the next intraneural space inwardly. Thus the pattern gives a picture completely different from the actual aspect of the butterfly and shows the portions that are accentuated by bluish iridescence and by the ultra violet reflection. These characters, in slightly less pronounced form, are observable in a similar photograph of the other female of *comstocki*.

On the same photographic plate the reverse of the typical *rorata* female from Haiti does not show this peculiar distribution of bluish iridescence. The dark, broken transverse band spreading from the apex of the front wings is visible, the dark mesial band of the hind wings is also apparent, only the irregular dark markings between that band and the outer margin are obliterated by the presence of an iridescence which produces a uniform-tone effect in this area. Both forms from Haiti and Jamaica show six minute, iridescent, antemarginal dots on the front wings. They lie immediately inward as compared with the corresponding visible dark brown dots at the tips of the veins. It is a strange phenomenon to observe a complete similarity of the underside of the *rorata* from Haiti and of the form from Jamaica, which in photography shows an entirely different picture when taken on a plate susceptible to the recording of the iridescence and the neutralization of the straw-yellow tone of the background, and the purple-brown markings. In studying the characteristics of the iridescent pattern of *comstocki* from Jamaica, as compared with the visual properties of the pattern, one may describe the situation as the superposition of two patterns. These two patterns do not coincide so that either yellow or purple-brown pigmental scales may have or may not have the structural properties producing iridescence. The pattern, de-

pending on structural characteristics of the scales, should be considered at least of equal systematic importance with the pattern produced by pigmental variations. In this respect the divergence of the Haitian and Jamaican forms of *rorata* should not be minimized, although the two Jamaican females do not show the phenomenon in the same intensity. This incidental discovery has prompted some comparative studies of a variety of other representations of this genus, with the same photographic methods, and has disclosed the following results:

The iridescence on the reverse of the wings may be independent from the visible light and dark pattern on the background. This relationship in *Phoebis* may fall into four types:

1. No visible presence of iridescence at all, like *eubule* and *agarithe*.
2. A general spreading of light iridescence, as in *philea*.
3. An even antemarginal iridescence, apparent in both wings, without a definite inner boundary, as in *avellaneda*.
4. A specific iridescence as in *argante*, following the outline of the visible dark pattern only approximately and usually slightly dislocated inwardly.

In the case of the Jamaican *rorata* the iridescent pattern acquires the maximum divergence as compared with the visible part, while the Haitian *rorata* shows a more general suffusion of iridescence over the pattern which is thus obscured in its outlines through closer coincidence. The difference of the Jamaican and Haitian topomorphs is not very striking in this regard, so far as the available material shows, but it indicates these two divergent tendencies.

Since iridescence depends on structural properties of scales producing an interference of rays, and the color depends on pigmentation, it must be surmised that a different set of hereditary factors governs these two phenomena. Consequently the systematic and taxonomic importance of iridescence, as compared with the underlying visible pattern, should not be overlooked since it may lead to some interesting lines of comparative investigations.

EXPLANATION OF PLATE I

All specimens photographed on a panchromatic plate with the use of a yellow filter, except as indicated.

FIGS. 1, 7-9. *Phoebis rorata* Butler.
Specimens from Pétionville, Haiti.

- FIG. 1. ♂, underside.
- FIG. 7. ♀, underside.
- FIG. 8. ♀, upperside.
- FIG. 9. ♀, underside, photographed without a filter.

FIGS. 2-6. *Phoebis rorata comstocki*, subsp. nov.

- FIG. 2. Type, ♂, underside, Bath, Jamaica.
- FIG. 3. Type, ♂, upperside, Bath, Jamaica.
- FIG. 4. Allotype, ♀, underside, Hampton Court, Jamaica.
- FIG. 5. Allotype, ♀, upperside, Hampton Court, Jamaica.
- FIG. 6. Allotype, ♀, underside, photographed without a filter.





American Pierid butterflies, photographed on a process plate without the use of a filter. A bluish iridescence and the ultra violet reflection accentuate a superimposed pattern in many of the forms.

Specimens in the collection of the Carnegie Museum.

- FIG. 1. *Phoebis thalestris* Ill., ♀, Haiti.
 FIG. 2. *Phoebis philea* L., ♀, Venezuela.
 FIG. 3. *Phoebis avellaneda* H. Sch., ♀, Santiago de Cuba.
 FIG. 4. *Phoebis fornax* Butler, ♀, Nueva Geron, Isle of Pines.
 FIG. 5. *Phoebis argante* F., ♀, Wismar, British Guiana.
 FIG. 6. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
 FIG. 7. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
 FIG. 8. *Phoebis argante* F., ♀, Guatemala.
 FIG. 9. *Phoebis rorala comstocki*, subsp. nov., ♀, Jamaica.
 FIG. 10. *Phoebis argante* F., ♀, Costa Rica.
 FIG. 11. *Phoebis argante* F., ♀, Venezuela.
 FIG. 12. *Phoebis argante* F., ♀, Guatemala.
 FIG. 13. *Phoebis sennae* L., ♀, Haiti.
 FIG. 14. *Phoebis agarithe* Bsd., ♀, Nassau, Bahamas.



American Pierid butterflies, photographed on a panchromatic plate with the use of a yellow filter. Specimens are the same ones shown on Plate II.

Specimens in the collection of the Carnegie Museum.

- FIG. 1. *Phoebis thalestris* Ill., ♀, Haiti.
- FIG. 2. *Phoebis philea* L., ♀, Venezuela.
- FIG. 3. *Phoebis avellaneda* H. Sch., ♀, Santiago de Cuba.
- FIG. 4. *Phoebis fornax* Butler, ♀, Nueva Geron, Isle of Pines.
- FIG. 5. *Phoebis argante* F., ♀, Wismar, British Guiana.
- FIG. 6. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
- FIG. 7. *Phoebis hersilia* Cr., ♀, Buenavista, E. Bolivia.
- FIG. 8. *Phoebis argante* F., ♀, Guatemala.
- FIG. 9. *Phoebis rorata comstocki*, subsp. nov., ♀, Jamaica.
- FIG. 10. *Phoebis argante* F., ♀, Costa Rica.
- FIG. 11. *Phoebis argante* F., ♀, Venezuela.
- FIG. 12. *Phoebis argante* F., ♀, Guatemala.
- FIG. 13. *Phoebis sennae* L., ♀, Haiti.
- FIG. 14. *Phoebis agarithe* Bsd., ♀, Nassau, Bahamas.

07.73
54P6842

ART. V. A NEW TERRESTRIAL VULTURE FROM THE
UPPER EOCENE DEPOSITS OF WYOMING



BY ALEXANDER WETMORE

Annals of the Carnegie Museum

Vol. XXX, p. 57-69

Issued May 24, 1944

Pittsburgh, Pa.



Restoration, by Walter A. Weber, of the terrestrial vulture described on page 58. The birds are shown against a background of landscape designed to represent the ecological conditions of the late Eocene of Wyoming. The bird in the foreground is about one-seventh natural size.

ART. V. A NEW TERRESTRIAL VULTURE FROM THE UPPER EOCENE DEPOSITS OF WYOMING

BY ALEXANDER WETMORE

ASSISTANT SECRETARY, SMITHSONIAN INSTITUTION

(PLATES I-V)

During field work under the direction of Dr. John Clark in Sweetwater County, southeastern Wyoming, in the season of 1941, the Carnegie Museum secured a partially complete skeleton of a remarkable bird that, through the kindness of Dr. A. Avinoff, Director, and Dr. J. LeRoy Kay of the Section of Vertebrate Paleontology, has been forwarded to me for study. Skulls of birds in fossil state are rare, so that most of our knowledge of the extinct avifauna of the World comes from wing and leg bones. The present specimen has a skull in a good state of preservation, and with it are associated parts of enough of the skeleton (*see* plate II) to give a fairly complete representation of the most remarkable bird that has come to my hands for description and a name. The species is one that belongs among the vultures of the New World in the Suborder Cathartae, and one that introduces an entirely new type of bird into that assemblage. Its form and specialization are of a kind that has not been suspected, since it is most anomalous to encounter in this group of species, marked by their ease and skill in flight, a relative that is evidently specialized for life on the ground, in which the ability in soaring, so highly developed in its relatives, was certainly entirely absent.

According to data given to me by Dr. Clark, the specimen was embedded in a relatively fine sandstone that was fairly soft in character, in the upper part of the Washakie formation of the Upper Eocene. The skeleton apparently had been overturned in some way before becoming finally embedded prior to fossilization, since the under sides of several bones were mechanically fractured. The specimen has been prepared with great skill so as to preserve delicate structures that if lost would have left the relationships of this strange bird in considerable doubt. As it is there is no question as to its affinities.

The drawings illustrating this specimen were made by the late Mr. Sydney Prentice of the Carnegie Museum. In addition, Walter A. Weber of the U. S. National Museum has prepared under my suggestion a restoration of the bird as it may have appeared in life.

The species may take its place in the group of others known from the Eocene under the name of

***Eocathartes grallator*, gen. et sp. nov.**

Characters: A bird of the suborder Cathartae, with degenerate wings, heavy pelvis, long legs, and large skull with large orbits, large narial aperture and strong premaxilla and mandible; longitudinal axis of mandible nearly straight, not decurved; lachrymal fused with the frontal; narial region open, and the olfactory cavity relatively large; palate exhibiting the arrangement of indirect desmognathism that marks the Cathartae as a group; processes for muscular attachment on the cervical vertebrae large and strong; pectoral girdle weak, with coracoid relatively small and non-pneumatic; tibio-tarsus long and heavy; tarso-metatarsus long and slender; anterior toes relatively long and strong; hallux weak, and apparently with a slightly elevated attachment on the shaft of the meta-tarsus.

Description: Type, a partial skeleton, Carnegie Museum Department of Vertebrate Paleontology, no. 9377 (field no. 2-35, 1941), from the Upper Washakie deposits of the Eocene, collected from the east bank of the main sand wash, one-half mile north of the Dobe Town road crossing, Sweetwater County, Wyoming, by H. Stoll, August 21, 1941.

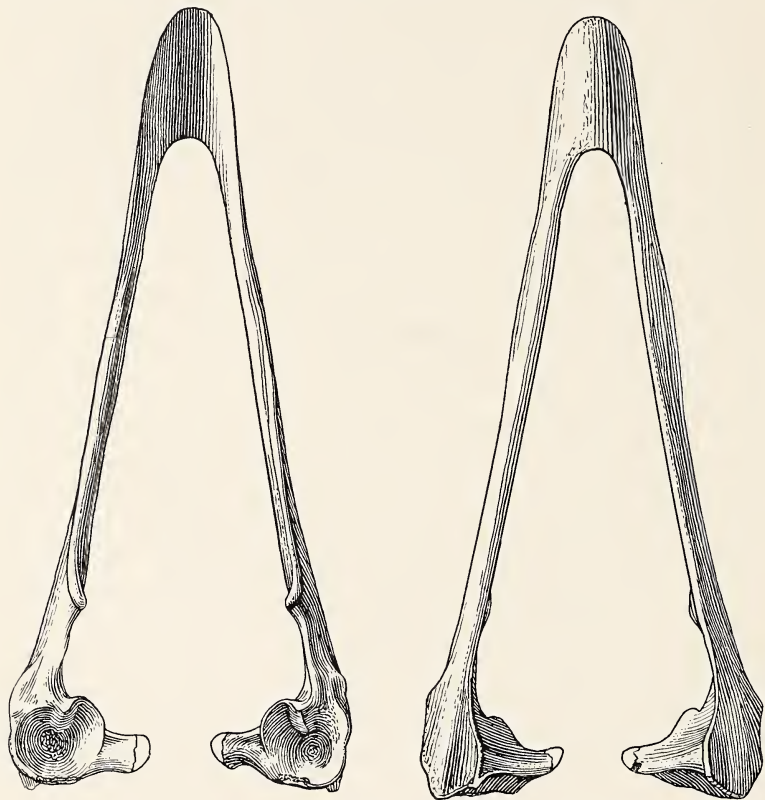
Skull: (Plate III, figs. 1-3; text-figs. 1, 2). Right side fairly complete, with slight displacement of quadrate and adjacent bones; anterior part of frontal damaged except along orbit, left side forward to nasal mainly missing except for quadrate, with a section of the quadrato-jugal still partly buried in the matrix. Cranium relatively broad, with indication of brain capacity apparently equivalent to that of modern species of the suborder Cathartae; basal portion distorted or missing; squamosal relatively small but strongly developed; temporal fossa large; post-orbital process much stronger and heavier than in modern Cathartae; orbital opening large (anterior margin on right side displaced by crushing); lachrymal of moderate size, fused with the frontal, with a large opening through its inner base for the passage of the olfactory nerve; nasal with descending process slender; nasal process of premaxilla also slender; narial opening decidedly larger in proportion than in modern Cathartae; premaxilla anterior to the narial opening strong, with a decided hook at the end, vaulted on the lower surface, so that the lower margins are sharp edged; maxilla relatively large, with a well-developed depression for the articulation of the maxillary process (the superior anterior division of the

maxillo-jugal, which is not preserved in the specimen), this depression involving the upper margin of the maxilla and the lower anterior end of the nasal; quadrate large and heavy, with two well developed heads; the squamosal facet broad and heavy; the opisthotic facet somewhat smaller, but relatively of good size; the orbital process broad and strong; anterior end only of the right pterygoid exposed, this being rather slender, with slightly expanded anterior end; a basipterygoid process indistinctly evident; quadrato-jugal rather strong, with a well developed articulation with the quadrate (the anterior end fragmentary); palatines relatively broad, scroll-like behind, broader and heavier anteriorly; free portion of maxillo-palatines apparently small, with the anterior margins closely applied to the palatines (as in modern *Cathartes*); posterior portions on either side joined through ankylosis with the nasal septum. Total length (approximate) 124.5 mm.; distance from cranio-facial hinge to tip of premaxilla (approximate) 68.0 mm.; depth of premaxilla at center of narial opening 18.5 mm.; length of maxillo-jugal (approximate) 59.0 mm.

Mandible (plate III, fig. 3; text-figs. 1, 2) complete, except for articular portion of left ramus, and some parts of the adjacent posterior section. Posterior margin truncated, and the posterior mandibular process developed only as a slightly indicated crest, with the surfaces internal to it irregularly and shallowly concave; internal mandibular process strong and heavy, with truncated end; external mandibular process a roughened, elongate, heavy-based ridge; articular surface deeply and irregularly concave; upper margin of mandible, viewed from the side, nearly straight to the symphysis, there being only a very slight downward curvature at the middle; coronoid process slightly developed; external face of ramus somewhat excavated posteriorly, with a narrow, elongate, closed depression marking the location of the anterior foramen found in some birds; symphysis fairly heavy. Total length (approximate) 104.5 mm.; depth of ramus at widest point (through the angulare, slightly anterior to the coronoid process) 16 mm.

The fused lachrymal, the condition of indirect desmognathism formed by the fusion of the inner margins of the maxillo-palatines on either side with the nasal septum to form a transverse bridge above the palate, and the depression in the posterior margin of the maxilla for the articulation of the upper anterior division of the maxillo-jugal, are characters that mark members of the suborder Cathartae from other birds. The skull as a whole is relatively large, and the premaxilla strong, with the articulation for the anterior dorsal end of the maxillo-jugal, together with the well-

developed orbital process of the quadrate, indicating a well-developed, flexible cranio-facial hinge. The narial aperture is as large as that of the South American condor, though the skull itself is much smaller. It seems



FIGS. 1, 2. Dorsal and ventral views of the lower mandible of *Eocathartes gallinator*, natural size.

quite probable that the nares in life may have been pervious. The texture of the surface of the cranium, with the relative size of the irregular furrows for blood vessels that extend from the margin of the posterior part of the orbit, when compared with other Cathartae, make it probable that the head was covered with a thickened skin and therefore bare of feathers.

The strong bill appears straighter, less decurved than in the other Cathartae, though this condition may have been modified somewhat by distortion during fossilization.

Tongue: The two basi-branchials (plate IV, fig. 1) of the tongue are present, having been found in place by the preparator. The shaft in these is slightly curved through distortion, rounded and slender, and at the proximal end is flattened and expanded to form the articulation with the basihyal. Adherent to the left side of the atlas vertebra is a slender stylus of bone that may represent the distal part of one of the cerato-branchials. Length of the longest basi-branchial 37.9 mm.

The presence of these parts of the tongue is unusual as they have seldom been found in fossil birds.

Pelvis: The fragments preserved include the line of fused vertebrae (plate IV, fig. 4) with the anterior and some of the posterior parts of the ilium, a partial ischium, and part of the pubis on the right side. The bone is large and strong, being approximately one-third larger than the pelvis in *Cathartes aura*, and is of decidedly heavier form. The form has been considerably distorted during fossilization, so that not much detail, aside from size and evident strength, is available for description. The pre-acetabular portion of the ilium appears to have been more angular than in living Cathartae, to afford attachment for larger, stronger muscles. The fused sacral vertebrae form a decidedly longer element in the pelvis, and the ilio-ischiatic fenestra is longer. The general appearance is one of strength to support a heavy musculature. Along the line of the vertebrae the bone as preserved measures 118.5 mm., but in life it was probably appreciably longer.

Vertebrae: The line of cervical vertebrae, more or less broken, is evident in the photograph of the skeleton as it lay in the matrix before removal (see plate II). The fragmentary atlas (text-figs. 3, 4) includes the dorsal section—the neural arch above the spinal canal, which is relatively long,



FIGS. 3, 4. Anterior and lateral views of the atlas and axis of *Eocathartes grallator*, natural size.

resembling a fairly heavy collar. The lower part carrying the articulation for the reception of the occipital condyle of the skull is missing. The portion present measures 10.6 mm. in transverse diameter.

The axis (text-figs. 3, 4) is relatively strong and heavy, with the hypo-

physis produced ventrally as a strong plate (relatively much larger than in living *Cathartae*), and the neural spine also heavy (distal end missing). The odontoid process is relatively strong.

Possibly nine other vertebrae which belong in the cervical series are represented by fragments, though with one exception these are so broken and distorted that they cannot be certainly identified. The only one that is fairly complete seemingly is the twelfth cervical (text-figs. 5, 6). This



FIGS. 5, 6. Dorsal and lateral views of twelfth cervical vertebra of *Eocathartes grallator*, natural size.

differs from the corresponding bone of modern *Cathartae* in having a flattened, bladelike hypophysis of good size. The neural spine is rather low but is strong and heavy. Another fragment seemingly represents the dorsal part of the eleventh cervical (text-fig. 7). The other bits preserved do not present identifying characters.



FIG. 7. Dorsal view of the eleventh cervical vertebra of *Eocathartes grallator*, natural size.

The indication from the vertebrae is that the neck was stronger than it ordinarily is in the *Cathartae*, with the processes for muscular attachment decidedly larger and heavier. This is shown by the relative size of the atlas and the axis, and by the large hypophysis on what is believed to be the twelfth cervical. This is quite different from the low process in the living species.

Ribs: A few fragments of the ribs have been preserved but show no characters of interest.

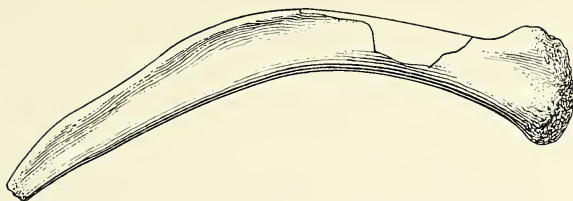


FIG. 8. Dorsal view of scapula of *Eocathartes grallator*, natural size.

Scapula: The articular end and the blade of one scapula (text-fig. 8) were found. These are flattened somewhat, and have been modified so that their original form is obscured. Apparently they belong to the right side. The bone is slender, with the head relatively small, and the distal section lightly formed. It appears to have been longer, and more attenuate proportionately, than in living Cathartae.

The scapula appears thus decidedly weaker than in the living, flying species, an indication of a poorly developed wing.

Coracoid: A considerably distorted coracoid (plate IV, fig. 2) apparently represents the bone of the right side. It is slender, more similar to this bone as it is found in galliform species than in the Cathartae, being so different that if disassociated from the present skeleton its true affinities would not be recognized. The head appears small and little developed, the shaft remarkably slender, and the bone relatively short for the size of the bird. The sternal facet is narrow and weak, though apparently fairly long. The bone appears to have been non-pneumatic. There is present also the fragmentary distal section of the left coracoid which bears out the slender, weak form described above. At its narrowest point the shaft in the complete bone is only 5.6 mm. in transverse diameter, and seemingly was only about 60 mm., or very slightly more, in length.

The appearance of the coracoid is such as to indicate at once that the bird was one of decidedly weak powers of flight.

Humerus: This element is represented by two distorted fragments that come from the left side (plate IV, figs. 6, 7), being in size between one-half and two-thirds the dimension of the turkey vulture. The head is missing, but, judging from the base of the shaft that supported it, it is evident that it was relatively small. The remnants of the deltoid crest indicate that this point of attachment for the left breast muscle was reduced in size and only lightly developed. The shaft is relatively slender,

and appears to have had a considerable sigmoid flexure. A small section of the shaft is missing below the center. The distal end shows a shallow, poorly defined, brachial depression, and indication of light development of the condylar area. The shaft appears rather heavy in relation to the somewhat expanded ends, the indication being that it may not have been pneumatic.

Ulna: The proximal end of the left ulna remains articulated with the humerus just described but is too broken to display useful characters. The proximal end of the right ulna (plate IV, fig. 3) preserved is considerably crushed so that the shaft is flattened, while the outer layer of bone is largely missing from the anconal surface because of abrasion. It is a slender bone, about one-half the size of that of *Cathartes aura*. The olecranon (somewhat abraded) is broadly rounded, the internal cotyla a shallow cup, and the shaft of the bone is relatively slender. The raised area for the attachment of the anterior ligament appears disproportionately heavy, the depression for the attachment of the brachialis anticus is well marked and fairly long, and the intermuscular line faintly indicated.

Carpometacarpus: A fragmentary bone from the right side (text-figs. 9, 10) lacks practically all of the first metacarpal except for the articular facet for the pollex. The bone is about one-half the size of that of the modern turkey vulture. The second metacarpal is rather slender, with no marked processes or lines evident, though these may have been partly obliterated by crushing. The distal end is truncated, with only a slightly projecting tuberosity. The intermetacarpal tuberosity shows a very slight elevation near the center of the shaft, and the tendinal groove while fairly wide is very shallow and faint. The third metacarpal, while somewhat flattened by pressure, appears disproportionately large in relation to the size of the second. It is flattened, and forms a distinct downward arc of a more decided sweep than is usual. The distal symphysis that joins the second and third metacarpals is relatively broad, and the distal end of the bone is truncated. From the articulation for the pollex to the distal end the bone measures 37.4 mm.

Pollex: This is somewhat distorted but was found in position. It is a slender, attenuate stylus that terminates in a fine point. While its total length may have been slightly increased by crushing, this could not have enlarged it greatly so that its extent over more than one-half of the length of the second metacarpal is surprising. The base is fairly heavy, and the distal tip finely attenuate. As preserved it is 22 mm. long. The indica-

tion is that the alula, in comparison with the remiges, may have been of larger size than customary in modern birds.

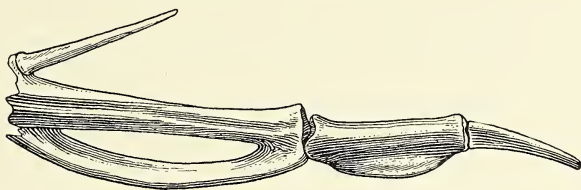


FIG. 9. Outer aspect of part of right carpometacarpus, pollex and digits of *Eocathartes grallator*, natural size.

Manus: The first phalanx of digit 2 is long and relatively narrow, being 21.8 mm. long by 7.5 deep at the widest point. The second phalanx of this digit is missing. The third digit is a narrow, elongate style that from a narrow base tapers to a point, the tip of which has been broken and lost.

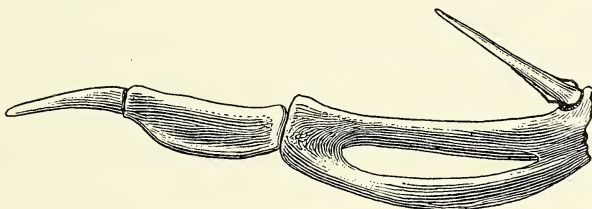


FIG. 10. Inner aspect of part of right carpometacarpus, pollex and digits of *Eocathartes grallator*, natural size.

While the wing is only partly preserved, the entire picture that it presents is one of much reduced function, more so than is the case in most ground living species of birds. The general proportions of the wing, so far as they may be ascertained, are not unlike what is found in the road-runner (*Geococcyx californianus*), a ground-inhabiting cuckoo that walks or runs as its habitual method of progression, but that can spring into the air, if necessary, to sail away on its wings. *Eocathartes* apparently was almost entirely terrestrial, though its wings may have served to carry it away from sudden dangers. While not entirely flightless, the condition presents an amazing contrast with the wing development and use in the other Cathartae.

Femur: Parts of shafts of the two femora were found, both with the ends broken so that they offer comparatively little descriptive data, except that they indicate a development different from that which is normal

among the living New World vultures (plate IV, fig. 5). The intermuscular lines are long and well marked, and the trochanteric ridge seems to have been heavy. There is no indication of the pneumatic foramen below the trochanter, though it is barely possible that this was located in the section missing from this area. The shape of the shaft indicates a strong, elongated form, with the axis nearly straight.

Tibiotarsus: The right tibiotarsus (plate V, figs. 1-4) is present, except for the proximal end. The shaft is distorted, and the distal end more or less modified by pressure. The length and heavy build of the bone are remarkable compared to that of modern forms, it being nearly twice the length, and even more than twice as heavy, than the tibiotarsus in *Cathartes aura*. The external condyle has the rounded form of *Cathartes*, but the shaft above is much heavier. The fragmentary inner condyle, so far as present, is also like *Cathartes*, with an equally large internal ligamental prominence. The intercondylar sulcus is deep, wide and open. The supratendinal bridge has been broken away, but seemingly was wide, as would be expected. The very strong, heavy shaft is fairly straight, and on the upper section has the outer cnemial crest broken off, but bent back and adherent to the main shaft. There is indication also of a part of the fibular crest, and of the long, slender style of the fibula, in which the head and the distal end are missing. The total length seemingly must have been near 210 mm. The external condyle measures 16.5 mm. across, and the bone as preserved measures 17.4 mm. transversely across the condyles.

Tarsometatarsus: The right metatarsus (plate V, fig. 5) is partly preserved with the shaft and most of the middle trochlea present, with only bits of the lateral trochlea. The head and the posterior part of the bone are fragmentary or missing. The trochlea from the left side, somewhat distorted, is also present. The bone was remarkably long, being more than twice the length of that of *Cathartes aura*, and nearly twice that of *Coragyps atratus*. The shaft appears relatively slender for its length, with a well impressed furrow on the anterior face near its upper end. The middle trochlea is compressed laterally but is fairly large. The two lateral trochlea show strong form. The facet for the articulation of the hallux is very indefinitely indicated, but it appears to have been small and somewhat elevated. The inferior foramen was small, with a narrow, shallow groove leading into it on the anterior surface. The metatarsus seems to have been about 135 mm. long, with the shaft near the center approximately 8.5 mm. in transverse width.

Pes: The set of phalanges is not complete, but the thirteen bones pre-

served serve to indicate the size and form of the foot (plate V, fig. 6) with fair accuracy. Four of the total number are incomplete, and all are more or less worn so that allocation to right or left sides is not attempted.

The first digit, or hallux, has the basal phalanx missing. The second phalanx is relatively small and slender, and the ungual phalanx, while well developed, appears rather weak. The size is about as in *Cathartes aura*. The second phalanx measures approximately 5.9 mm. in length, and 3.2 mm. in transverse breadth at the center of the shaft, with the distal end 4.2 mm. broad transversely. The unguis is 11.5 mm. long. The appearance of these two segments of the hallux supports the supposition that the first toe had become somewhat weakened, as is usual in a running bird.

The second digit is represented by a basal phalanx with a fragment of the base of the second phalanx adherent to its distal end (though twisted in its attachment), and a complete second phalanx. The basal phalanx is decidedly longer and heavier than in *Cathartes aura*, being strongly developed with a broad, strong base. This bone measures 20.8 mm. in length, 5 mm. in transverse breadth at its narrowest point, 7.3 mm. in transverse breadth on the proximal end, and 6.4 mm. in transverse breadth at the distal end. The second phalanx is relatively more slender, being more as in *Cathartes*. It measures 18.9 mm. in length, 3.9 mm. in transverse diameter at the center, 5.1 mm. in transverse breadth at the proximal end, and 4.6 mm. in transverse breadth at the distal end.

From the third digit there is one first phalanx and part of a third with the claw attached. The basal phalanx is long, with a relatively slender shaft and a strong base. It measures as follows: length 29.4 mm., smallest transverse breadth of shaft 5.4 mm., transverse breadth of proximal end 7.7 mm., depth of proximal end 9.4 mm., and transverse breadth of distal end 7.8 mm. The proportions are much as in *Cathartes aura*, but the base is heavier. The third phalanx lacks about one-fourth of the proximal end. It is slightly heavier than in *Cathartes*, but may not have been a great deal longer. The transverse width of the distal end is 5.8 mm. The claw, which has the tip missing, is about as long as in *Cathartes*, but is slightly heavier.

For the fourth toe there are present one first phalanx complete, and about two-thirds of the other one, a third, and a fourth phalanx, and an unguis. The first phalanx is strongly built and heavy, being decidedly larger than in *Cathartes aura*. It has the following measurements: length 18.2 mm., transverse breadth at base 7 mm., transverse breadth near center 4.2 mm., and transverse breadth of distal end 5.6 mm. The second

phalanx is not preserved. The third phalanx compared with that of *Cathartes* is heavy, the bone being thicker and stronger. It measures as follows: length 9.5 mm., transverse breadth of proximal end 5.1 mm., of shaft near center 4.0 mm., and of distal end 4.5 mm. The fourth phalanx, which was found articulated with the third just described, exhibits the same relatively heavy form when compared with *Cathartes*, measuring as follows: length 12.2 mm., transverse breadth of proximal end 4.2 mm., of shaft near center 3.4 mm., and of distal end 4.1 mm. The unguis is relatively heavy. As stated above, its tip is broken and missing.

The heavier part of the leg seems to have been that part extending from the tibio-tarsus to the pelvis. The tarso-metatarsus is relatively slender, a comparatively slight construction that, in a way, is carried along to the toes. The appearance of the foot is somewhat similar to that of *Cathartes aura*, but the anterior toes are heavier and longer, the three anterior digits being actually larger, with heavier form. The hallux, on the contrary, is actually very slightly smaller, so that the proportions of the foot, as a whole, are somewhat different. The anterior toes, however, show distinct modification for terrestrial locomotion in their strength and length, while an allied modification appears in the decreased size of the hallux.

Taxonomic position: *Eocathartes grallator* is the strangest of the fossil birds that it has been my privilege to describe to date, its peculiar characters being of a kind unknown until now in the suborder Cathartae. The bird in the flesh lived in a completely different ecological niche from that of the vultures found in the New World today, its status in relation to the other known forms being comparable to that which the secretary-birds, the Sagittariidae, bear to the hawks, ospreys and falcons. The restoration (plate I) of *Eocathartes*, prepared under my suggestion by Walter A. Weber of the U. S. National Museum, has been based on a careful comparison of the fossilized bones with the skeletons of modern species of the family Cathartidae. In the development of a suitable background, with the hint of accessory vegetation, we have had the advice of Dr. Roland W. Brown, paleobotanist of the U. S. Geological Survey.

In the latter part of the Eocene in Wyoming, lakes of shallow water were frequent, with an abundance of fishes of the herring family. The horse-tail (*Equisetum*) was common, a fan palm, a climbing fern, and sumacs were found, and cat-tails grew in the water. Against such a setting a group of a half-dozen *Eocathartes* is shown in a variety of attitudes to demonstrate what it has been possible to deduce regarding

their bodily form and proportions. The head seemingly was covered with a thickened, vascular skin, and therefore may be supposed to have been bare of feathers, possibly to a lesser extent than in modern vultures. The tail is commonly somewhat elongated in long-legged terrestrial birds, and the proportions given the wing feathers are based on the relative sizes of the bones. After making an arbitrary choice of color pattern the actual colors may be left to the imagination, remembering that in our living vultures there is found a great variety ranging from the diversity of soft-hued tints shown by the king vulture, and the brighter colors of the bare head of this same king vulture and of the California condor, to the somber dress of the black and the turkey vultures. There is no color in the prismatic scale that is not indicated on one or another of this group of birds which ordinarily we think of as foul and unattractive scavengers. The somewhat slender form shown in *Eocathartes* has been developed from the weakened wing and coracoid which must have been accompanied by a slight development of the sternum and the muscles that covered it. The thickened neck is based on the strong cervical vertebrae and the evident attachments for heavy muscles that they display. The length of leg is easily seen in the fossil skeleton.

The peculiarities of *Eocathartes* are such that a new family, the Eocathartidae, is necessary to receive it, while similarly it is required that it be set off as a distinct superfamily, the Eocathartoidea. The distinctive characters for these two new groups are found in the specialized form, with degenerate wings, lengthened legs, and the other adaptations noted for a terrestrial life, together with the relatively considerable size of the skull, with its strong processes for muscular attachment and its large narial opening.

The schematic classification for the entire group of hawk-like birds will then stand as follows:

Order FALCONIFORMES, Vultures, Hawks, Falcons.

Suborder CATHARTAE, New World Vultures.

Superfamily EOCATHARTOIDEA, *Eocathartes* (fossil).

Family EOCATHARTIDAE, *Eocathartes* (fossil).

Superfamily CATHARTOIDEA, New World Vultures.

Family CATHARTIDAE, New World Vultures.

TERATORNITHIDAE, *Teratornis*, *Cathartornis* (fossil).

Suborder FALCONES, Secretary-birds, Hawks, Falcons.

Superfamily SAGITTARIOIDEA, Secretary-birds.

Family SAGITTARIIDAE, Secretary-birds.

Superfamily FALCONOIDEA, Hawks, Falcons and Allies.

Family ACCIPITRIDAE, Hawks, Old World Vultures, Harriers.

PANDIONIDAE, Ospreys.

FALCONIDAE, Falcons, Caracaras.



The skeleton of *Eocathartes grallator* in the rock in which it was preserved, as it was brought to the Museum. Photograph by Sydney Prentice, slightly less than one-half natural size.

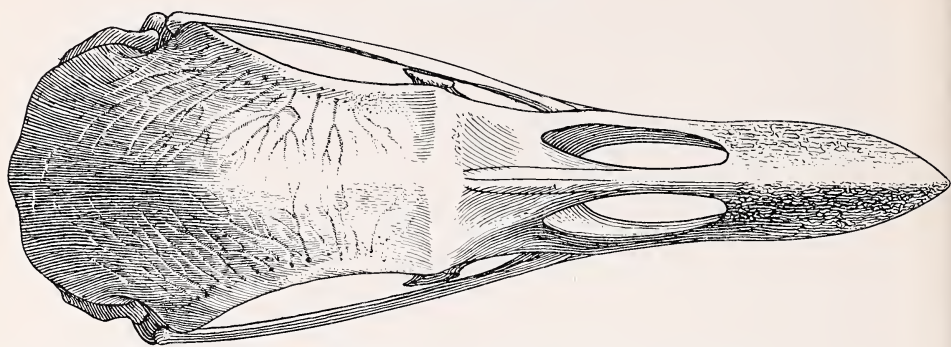
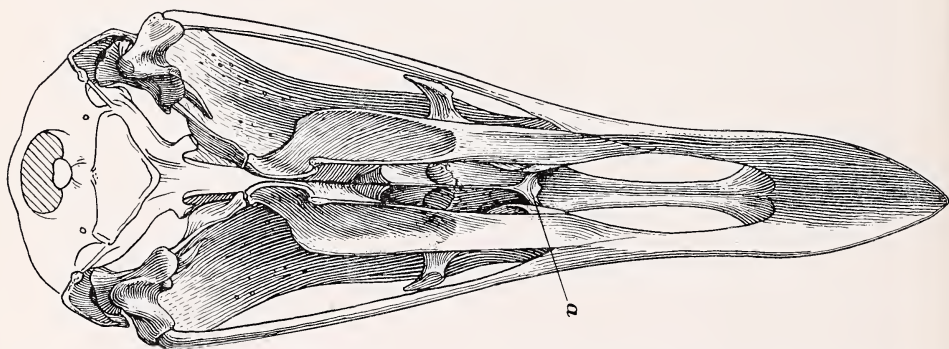
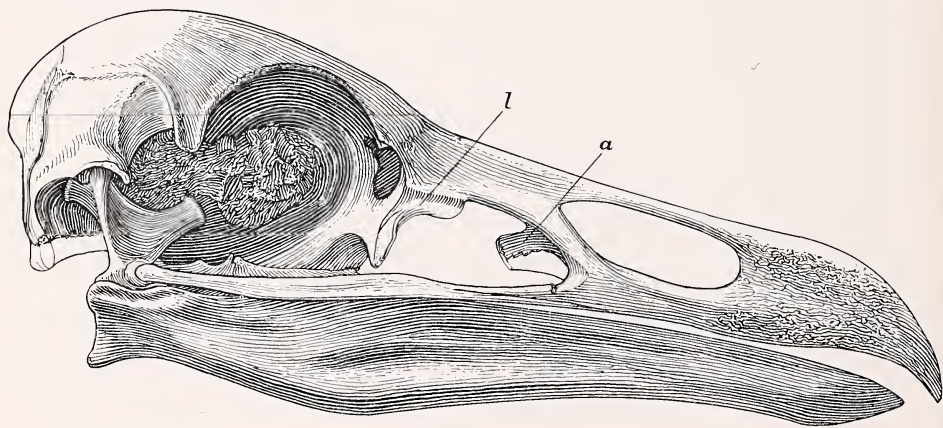
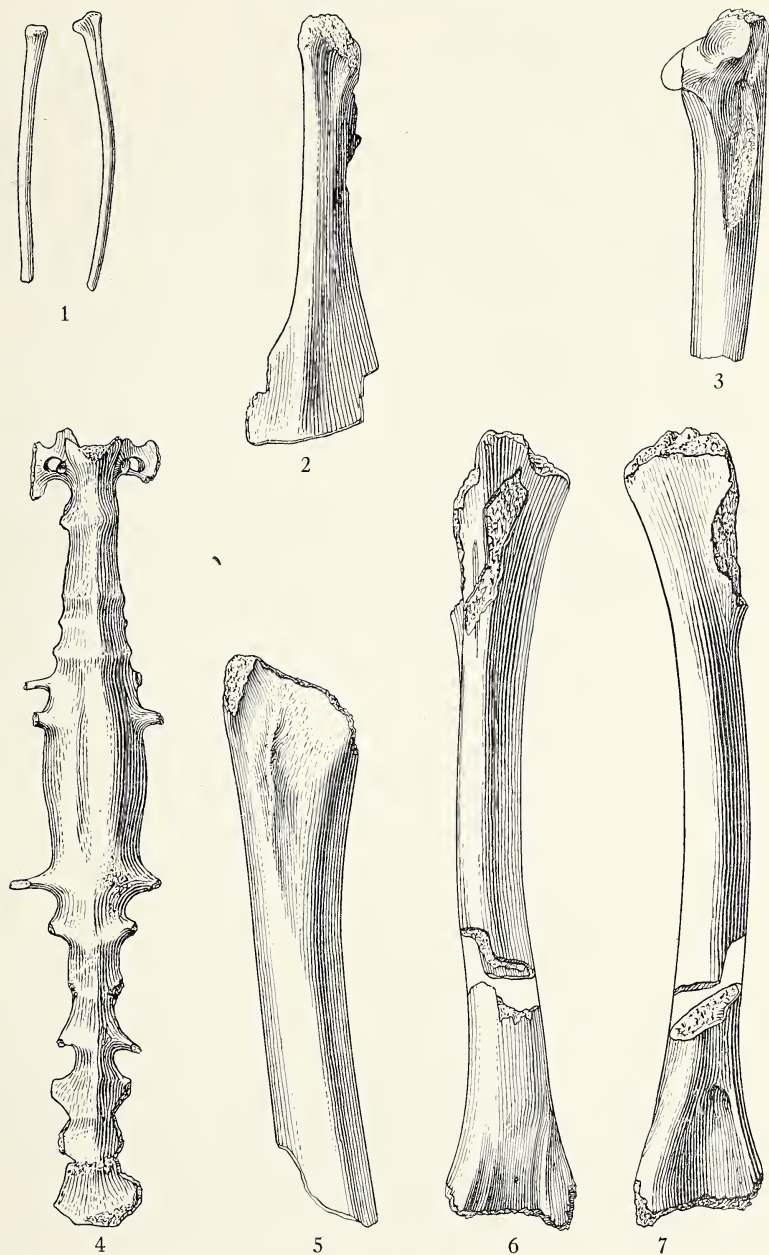
Eocathartes grallator

FIG. 1. Dorsal view of the skull, partly restored, slightly less than natural size.

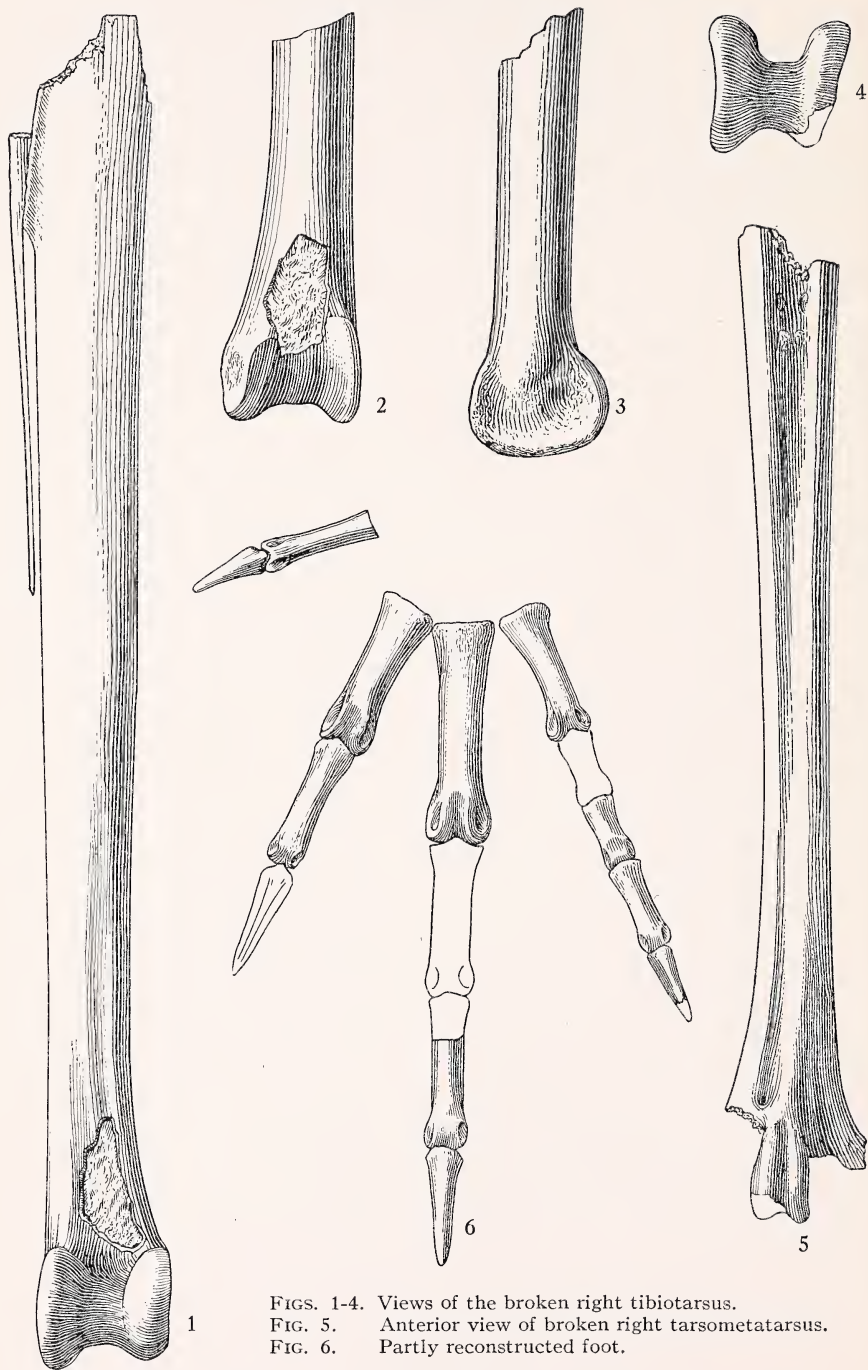
FIG. 2. Ventral view of the skull, partly restored. The un-shaded portion is not preserved in the specimen, but has been drawn from modern skulls of New World vultures. The bony bridge formed by fusion of the base of the maxillo-palatines and the nasal septum is marked at *a*. Slightly less than natural size.FIG. 3. Side view of the skull, partly restored. The fused lachrymal is marked at *l*, and the posterior part of the fused base of the maxillo-palatines and the nasal septum at *a*. About natural size.

Eocathartes gallator
All figures about natural size.



- FIG. 1. The basi-branchial bones of the tongue.
 FIG. 2. Anterior view of coracoid.
 FIG. 3. Proximal end of the right ulna.
 FIG. 4. Outline of the fused vertebrae found in the pelvis.
 FIG. 5. Dorsal view of fragmentary right femur.
 FIGS. 6, 7. Anterior and posterior views of the somewhat broken left humerus.

Eocathartes grallator
All figures about natural size.



FIGS. 1-4. Views of the broken right tibiotarsus.
FIG. 5. Anterior view of broken right tarsometatarsus.
FIG. 6. Partly reconstructed foot.

07. 73
4P6842

Carnegie Mus.
Annals.

ART. VI. ANOTHER NEW BOA OF THE GENUS EPICRATES
FROM THE BAHAMAS

BY M. GRAHAM NETTING

CARNEGIE MUSEUM

AND

COLEMAN J. GOIN

UNIVERSITY OF FLORIDA

In February, 1942, Dr. Arthur C. Twomey, Assistant Curator of Ornithology at the Carnegie Museum, spent a short period collecting birds in the northern Bahamas while the guest of Dr. Matthew T. Mellon aboard the latter's schooner, "Gerda II." Dr. Twomey, to whom we are indebted for many interesting specimens acquired during the course of his bird collecting forays, again returned with herpetological material. When we found that the collection of lizards and frogs also contained a small boid from Great Abaco, we were reminded of the recent statement of our good friend Dr. Thomas Barbour, "I do not know whether there is a fowl snake to be found on the Abacos or Grand Bahama. If so, it is not unlikely that this will prove to be another undescribed form" (1941. Proc. New England Zool. Club, 18: 62). Dr. Twomey's specimen proves that there is a fowl snake on Great Abaco, and study shows that it is an undescribed form. It would be a pleasure to associate Dr. Barbour's name with this novelty, in recognition of his astuteness as a prophet, were it not for the fact that we would be adding to the all too plentiful supply of homonyms by so doing.

Although the Carnegie Museum has a Bahamian collection of moderate size, acquired by gradual accretion since the first specimens were purchased from W. W. Worthington in 1909, very few snakes are included among the species represented. We sent our suspected novelty to Cambridge, therefore, and both Dr. Barbour and Mr. Arthur Loveridge were kind enough to examine it and confirm our surmise that it represents an undescribed form from these interesting islands, which are incompletely known herpetologically four and a half centuries after their discovery. For the new boa, we propose the name,

Epicrates exsul, new species

Type: Carnegie Museum, no. 21048, male, collected February 6, 1942, by Arthur C. Twomey.



MAY 27 1944

Type locality: Near Blackrock (approximately $26^{\circ} 49'$ N. lat. and $77^{\circ} 25' 30''$ W. long.) on the east coast of Great Abaco in the Bahama Islands.

Diagnosis: An *Epicrates* with a maximum of 37 scale rows, which can be distinguished from other Bahamian boas by the lower number of scale rows (*chrysogaster*, 40-44; *reliquus*, 46; *fosteri*, 50; and *strigilatus*, 51-53). Perhaps most closely related to *chrysogaster*, but differing from it in having a greater number of dorsal blotches, in lacking a prominent postocular stripe, and in having a relatively shorter head, as well as in the fewer scale rows and the differences in the formation of the prefrontals.

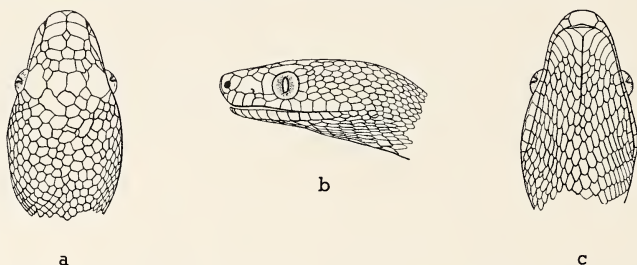


FIG. 1. *Epicrates exsul*; a, top of head; b, side of head; c, chin. Carnegie Museum, 21,048, type. About $1\frac{1}{3}$ times natural size.

Description of type: Body slender, laterally compressed, head distinct from neck. Rostral about as deep as wide, tip visible from above; internasals and anterior nasals combined into a single pair of scales, which are as long as broad. Four transverse rows of scales between the internasals and frontals, as follows: 1) An anterior row of one pair, broadly in contact on median line, outer posterior corners truncate. 2) A row, four plates in width, each of the inner pair slightly more than twice the size of those of the outer pair (a small diamond-shaped plate is interpolated on the median line between the first and second transverse rows, and is thus in contact with each plate of the first row and the median pair of the second row). 3) A row of five plates, consisting of a median plate with two lateral plates on each side, the outermost on each side being in contact with the upper loreal, preocular, and supraocular. 4) A row of five plates, the median about twice the size of the others, the outermost on each side in contact with the supraocular. Frontal divided to form three plates by a median suture which extends backward about two-thirds of its length and then forks, sending a branch posterolaterally on each side, thus forming a posterior median portion of the frontal; each lateral frontal rather narrowly in contact with the supraocular, being separated anteriorly by a

roughly triangular-shaped interpolated plate and posteriorly by the intruding parietals. Parietals small, that on right divided into three small plates, that on left undivided. Left loreal region sub-rectangular, largely occupied by a single plate, from the upper posterior corner of which a small plate is cut off by a diagonal suture. Right loreal region similar, but lower anterior corner of large loreal lopped off as well by a second diagonal suture. Supralabials, 13 on left, 14 on right; first supralabial in contact with internasal; second touching internasal, posterior nasal, and loreal; fifth on left side of head divided horizontally; sixth, seventh, and eighth entering eye on left side, seventh, eighth, and ninth on right. A large preocular and a smaller subpreocular on each side. Four postoculars. Temporal scales small, not quite so large as those on side of body. Inferalabials, 14 on each side. Scales smooth, in 37 rows at mid-body; 251 abdominals; 74 undivided subcaudals; anal entire; 30 abdominals occupying the same space as about 40 dorsals at midbody, the increase taking place in the fourth to the eighth row; anal spurs present.

Coloration: (Preserved specimen). Head, body, and tail pale brown above; cream colored beneath. A very faint, gray stripe from nostril through eye to angle of jaw; a slightly more visible, dusky, arrow-shaped marking on top of head, its point on second transverse row of prefrontals, its wings terminating on supraoculars; and a median, dark blotch from last frontal to rear of head. A double dorsal series of squarish or rounded, dark brown spots, frequently confluent across the back, extending from the neck to the tip of the tail, rather uniform-sized on body, smaller on tail; 58 of these spots on left side of body, 56 on right side. A single, incomplete series of a few small, widely separated, dark brown spots on the sides, becoming more frequent posteriorly, and occurring on the third to tenth scale rows on the body, and on the first to third rows on the anterior portion of the tail.

Measurements: Total length, 555 mm; tail, 111 mm.

Habitat: The following notes about habitat, and the additional reports of snakes, are based upon information provided by Dr. Twomey.

At Blackrock, Great Abaco, the original pine forest has been removed, but inland from Cocoplum Creek (about three nautical miles south of Blackrock) large stands of virgin pine forest still occur; here dense undergrowth makes penetration difficult, except along the trails which connect numerous small clearings. February 6 was chilly, with intermittent rain. Three snakes, which had apparently emerged from holes in the coral rocks to warm themselves in the sun, were seen along the margins of two

adjacent clearings. One (the type) was collected, but the other two, about the size of the specimen collected, escaped into crevices in the knife-edged, eroded rocks. The entire area was overrun with introduced wild pigs, for which the natives had set snare nets in the numerous runways. The negroes in the village of Blackrock told tales of seeing snakes ten feet long. One claimed to have abandoned his garden about six weeks earlier because he had seen a snake, as thick as his wrist, emerge from the bordering rock wall.

Additional reports of snakes: All of the northernmost islands in the Bahama group are located on the Little Bahama Bank, which is separated from the islands to the south by the Northeast Providence Channel and the Northwest Providence Channel, and from the east coast of Florida by the Straits of Florida. The only large islands on this bank are Great Abaco and Grand Bahama; these two islands are separated today, at their nearest points, by only about six miles of shoal water, scarcely more than six feet in depth. Both the large islands and numerous small cays are located along the outer margins of the bank, but the latter are most numerous along the northeast margin facing the Atlantic Ocean. Only a fraction of the 100-300 feet of emergence, generally believed to have occurred in the Bahamas during the cold intervals of the Pleistocene, would have been required to connect all the islands, islets, and rocks of the Little Bahama Bank into one large island.

Dr. Mellon's party was unable to land on Grand Bahama, except at Hawksbill Creek, an inlet on the southwest coast (approximately $26^{\circ} 31' 15''$ N. lat., $78^{\circ} 43'$ W. long.), where a forest of pines sixty feet high was observed. A resident here told Dr. Twomey that he was too early to secure snakes, but that they did occur in the area, and that specimens were occasionally seen during the warmer months.

Stranger's Cay (approximately $27^{\circ} 07'$ N. lat., $78^{\circ} 04'$ W. long.) was also visited by the party. This small cay, which is only about two miles in greatest diameter, reaches an altitude of eighty feet above sea level; hence, it is too high to be inundated by hurricane waves. It was found to support dense vegetation. An old negro resident asserted that the island was infested with snakes as late as World War I. At that time the British owner introduced pigs, and within two years the snakes disappeared. According to this man, the snakes which he had seen reached three feet in length and occurred on rocky slopes around a large swamp. The same informant said that snakes now occurred (in the northern Bahamas) only on Great Abaco.

Munjack Cay, lying about four miles east of Blackrock, and Powel Cay, about six miles north northwest of Blackrock, were visited. Residents on each of these islets reported that no snakes occurred there, but that snakes were to be found on the "mainland," *i.e.*, Great Abaco.

Relationships: Previously, the northernmost known representative of *Epicrates* has been *striatus fosteri*, from North Bimini, at the northernmost portion of the Great Bahama Bank. The finding of *exsul* on Great Abaco is the first evidence of the occurrence of snakes on the Little Bahama Bank. It would be very nice, from a zoögeographic standpoint, if we were able to state categorically that *exsul*, the northernmost form of the genus, was most closely related to the next form to the southwest, *E. s. fosteri*, but in all honesty we cannot do so. The North Bimini form, *fosteri*, although very distinct in its coloration (black ground color), agrees in scutellation with *striatus strigilatus* of the central Bahamas; *strigilatus*, in turn, is a derivative, possibly through *reliquus* of Sheep Cay near Great Inagua, of typical *striatus* of Hispaniola.

In view of the inadequacy of the comparative material in the Carnegie Museum collection, the junior author took the type of *exsul* to Philadelphia for comparison with examples of *Epicrates* in the collection of the Academy of Natural Sciences. The privilege of making these comparisons in the company of Dr. E. R. Dunn and Mr. Roger Conant, both of whom have worked upon the family, was of inestimable value. Upon direct examination, neither these workers nor the junior author could find any close resemblance between the specimen of *exsul* and specimens of *striatus* or *strigilatus*. Its striking similarity, however, to the type of *chrysogaster* Cope (the form inhabiting Turks Island and the Caicos Group) was immediately apparent. We realize that it is unwise for authors inexperienced in Bahamian herpetology to make generalizations about distribution in these islands, but the fact that *exsul* appears similar to the southeasternmost Bahamian form (*chrysogaster*) and quite different from the two nearby forms (*fosteri* and *strigilatus*) leads us to the inescapable conclusion that the Bahamas have been invaded by two different stocks of *Epicrates* from Hispaniola, the only West Indian island which is known to harbor more than one representative of the genus. According to this hypothesis, *fosteri*, *strigilatus*, and *reliquus* are the Bahamian representatives of the *striatus* group. The forms of this group are characterized by moderate to large size, 46-63 dorsal scale rows, 271-302 abdominals, a pattern typically of rhombs, and a relatively small eye. *E. exsul* and *E. chrysogaster* are the Bahamian representatives of the *inornatus-fordii* complex. The mem-

bers of this complex (*gracilis* and *subflavus* not included) are differentiated by their small to moderate size, 33-43 dorsal scale rows (with the single exception of the unique specimen of *granti* which has 48), 243-269 abdominals, a pattern of spots rather than rhombs, and a relatively large eye which is separated from the edge of the upper lip by not more than one-half of its own diameter.

Subsequent collecting in the Bahamas will probably yield additional herpetological novelties, and, possibly, even other representatives of *Epicrates*. We are not very sanguine, however, that enough new discoveries will be made to permit unequivocal mapping of the distribution of the snakes in the Bahamas as it was on the fateful morning of October 12, 1492, when Columbus made landfall at Watlings Island. This event was not immediately prejudicial to the snake population, as it was to the "Indian" population, but it set in motion a long chain of destructive factors which culminated in the cotton-planting period of the eighteenth century. We can only regret that no "Cinquecento" herpetologist had opportunity to wander through the then extensive stands of tropical hardwoods and to observe the large boas which, we believe, may then have fattened on the richer avifauna in the cool glades on many of the islands.

It is interesting to note, in closing, that some scholars believe that Europeans discovered the Antilles and Brazil prior to 1492. Certainly Antillia and Brazil are the only geographic names on American maps which have a cartographic history dating to pre-Columbian times. Babcock (1920, *Geogr. Rev.*, 9: 118) has even tentatively identified "I in Mar," of the Beccario Map of 1435, as Great Abaco and Great Bahama (considered as one island), or as sea islands in the vicinity. Even though the islands of the Little Bahama Bank *may* have been the first of the group to be discovered, there can be no question that they are still the least known faunistically. It is to be hoped that further herpetological collections may be made upon these islands, as soon as world conditions permit, before the remaining snakes of Great Abaco, and its neighbors, succumb to the ubiquitous pig.

7:73
P6842



ART. VII. *BRACHYURANOCHAMPSA EVERSOLEI*, GEN. ET
SP. NOV., A NEW CROCODILIAN FROM THE
WASHAKIE EOCENE OF WYOMING

BY RAINER ZANGERL
UNIVERSITY OF NOTRE DAME

(PLATES I-III)

Among the specimens collected by the Carnegie Museum in the Washakie Eocene of southern Wyoming in 1941, there is an exceptionally well preserved crocodilian skull, recently prepared by the writer. The specimen is very nearly complete; the lower jaws, however, are missing. It may be described as follows:

*Brachyuranochampsia** *eversolei*, gen. et sp. nov.

Type: Skull, Carnegie Museum number 9,372; collected by the Carnegie Museum Expedition of 1941.

Type locality: Washakie Basin one-half mile east of road between Bitter Creek and Baggs, about ten miles south of Kinney Ranch; Sweetwater County, Wyoming.

Horizon: Middle Washakie.

Diagnostic characters: The skull is triangular in shape; the fifth pair of maxillary teeth is largest, exceeding the fourth pair but slightly in size; both are considerably larger than any of the remaining maxillary teeth. The palatine elements are short, they do not reach the rostral margins of the posterior palatine vacuities and the palato-maxillary suture is anteriorly concave. The rear maxillary teeth are short and blunt while the anterior ones are conical and slightly curved. Unusually large and deep pits for the reception of mandibular teeth are located between maxillary teeth 7 and 8; smaller ones are clearly visible on both sides between teeth number 6 and 7, and 8 and 9. The supratemporal fenestrae are almost

*βραχύς, short; ὀψαρός, roof of mouth, palate (Aristot., Hist. Anim.)
Χάμψα, crocodile (Herodotus).

perfectly circular and are close together. The orbits are longer than broad and rather pointed in front. The interorbital plate is separated from the basis of the snout by a low, V-shaped ridge. The supraoccipital forms part of the cranial table. The nasal elements reach to the rear border of the external narial aperture, but do not extend into it.

During the very first stages of preparation a peculiar character was observed which appears to be unique among recent as well as fossil crocodilians. This concerns the shape of the palato-maxillary suture. Normally this suture is anteriorly convex, separating to a greater or lesser degree the posterior portions of the ventral horizontal wings of the maxillaries. In the form described here, the suture is anteriorly concave and does not reach to the forward margins of the palatine fenestrae. In other respects the skull greatly resembles such forms as *Leidyosuchus* and *Prodiplocynodon* from the Lance formation. The unusual combination of characters in the present specimen seems to justify the proposal of the new genus and species.

The species is dedicated to Mr. and Mrs. Roy Eversole of Bitter Creek, Wyoming, whose splendid hospitality and interest in our field work contributed greatly to the successful completion of our assignment. The writer wishes to thank Dr. J. LeRoy Kay and Dr. John Clark of the Carnegie Museum for the privilege of describing one of the results of the field work of the season of 1941.

Preservation: The skull was lying dorsal side down in the formation and was embedded in a fine clay. The extreme tip of the snout was exposed and a small portion of it was missing. No remains of the lower jaws or the postcranial skeleton could be found. The state of preservation was good; the roof of the skull shows very little, if any, deformation, but the pterygoids, ectopterygoids, palatines, and the ventro-medial wings of the maxillaries, were crushed and were cemented to the ventral surfaces of the roof bones of the skull. Fortunately the dislocation of these elements did not cause them to be greatly deformed and the bones in question could be placed approximately into their former positions. The ectopterygoids alone seem to have been somewhat flattened and could therefore not be brought into contact with the maxillaries. The palatines were uninjured except for a few transverse cracks.

General features of the skull: The outline of the specimen approaches very closely that of a modern crocodile skull, *e. g.* *Crocodilus porosus*; both the horizontal and the vertical festooning are pronounced, but not extreme. The notches at the premaxillary-maxillary sutures are rela-

tively deep. The snout is very flat and the surfaces of the cranial table and the basis of the snout decline rostrad to about the level of the fifth maxillary teeth; from there the roof of the snout ascends gently to a point near the posterior border of the external nasal opening. The very tip of the rostrum is slightly bent downwards. The quadrates are unusually high in position, particularly their distal ends which are not bent ventrad as in recent forms. There is no sign whatever that this condition might be due to crushing. The cranial table is considerably wider than long and the interorbital plate is quite narrow. The sculpturing of the skull surface is pronounced but not characteristic.

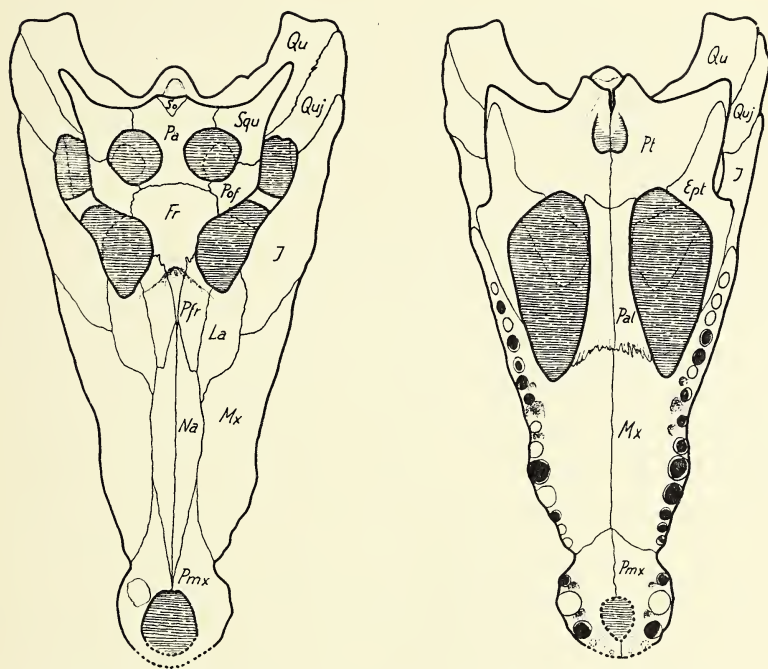


FIG 1. *Brachyuranochamps a eversolei*. Dorsal view (left) and Ventral view (right) of skull of type.

Bones of the skull: The sutures could be traced fairly well in all parts of the skull. The premaxillaries, of which the most anterior tips are missing, possess dorsally long, narrow processes reaching to the level of the fifth maxillary teeth. On the ventral side the premaxillary-maxillary suture is

V-shaped with the apex of the V not extending farther back than the region of the second maxillary teeth. Three alveoli, the first and last containing broken teeth on both sides, are preserved. Of the three alveoli in each premaxillary the last one is by far the smallest; the second last is unusually large. On the right side of the specimen the alveolus is open dorsally and the bone in the immediate neighbourhood is distinctly discoloured, a condition which might have been caused by an infection. The first preserved premaxillary alveolus is intermediate in size between the other two. Between this alveolus and its large neighbour there is a deep pit presumably for the reception of the second mandibular tooth. Another, more shallow, pit is situated between the middle and the last premaxillary alveoli. These pits do not separate the alveoli but are somewhat removed mediad from the tooth line.

The maxillaries carry fourteen alveoli each. Ten teeth are preserved on the right, and seven on the left side of the specimen. In most cases, however, only the roots are preserved. The alveoli of the fourth and fifth teeth are the largest in the series; the latter exceed the former but slightly in size. There are very large interdental spaces between the alveoli 6 and 7, 7 and 8, and 8 and 9. Remarkably deep pits are located in these spaces, apparently for the reception of large mandibular teeth. The largest of these pits lies between alveoli 7 and 8 (text-fig. 2). The anterior alveoli are approximately circular in outline, while the posterior ones are longer than wide. In the front portion of the maxillary the teeth appear to have been conical and anteriorly and posteriorly crested. In the rear part of the jaw the crowns are low and obtuse. Of particular interest is the maxillary-palatine suture. Although the ventral horizontal wings of the maxillaries are crushed, there is no doubt as to the course of this suture. It lies relatively far back at a point where the palatina are still thick. The suture itself is complicated and anteriorly concave (text-fig. 2 and plate II). It lies behind the tips of the palatine vacuities. Mook (1941) could not make out the suture in question in his recently described *Prodiplacynodon langi*, a genus which seems to be fairly closely related to the present one. It is, however, very unlikely that the two forms are identical in regard to the palato-maxillary suture, because if it were developed in *Prodiplacynodon* as it is in *Brachyuranochampsa*, Mook could not possibly have failed to observe it. The maxillary-nasal suture is unusually short, partly because of the long posterior premaxillary processes and also because of the length of the lacrymal.

The nasals reach their greatest width at the level of the seventh maxil-

lary teeth. Their posterior tips are but slightly separated by the rostral process of the frontal. The latter bone does not extend to the anterior rims of the supratemporal fenestrae. Behind these openings the parietal plate is wide, as in the Leidyosuchidae, and a triangular process of the supra-occipital takes part in the formation of the cranial table.

The shape of the quadrato-jugal is more nearly crocodiloid than alligatoroid; an antero-mediad process of this bone accompanies the aboro-medial margin of the infra-temporal fenestra, but does not exclude the quadrate from forming part of the rim of the opening; the presence of a so-called spina quadrato-jugalis is doubtful, for the edge of the opening at that point is slightly insured.

The interorbital plate is separated from the basis of the snout by a low, V-shaped bone wall as in *Prodiplocynodon langi* Mook, but it is more weakly developed than in the latter form.

The palatines are short. Their narrowest region lies at the level of the 14th maxillary teeth. The posterior processes of the pterygoids near the median plane are very large, but different in shape from those in *Prodiplocynodon*.

Openings of the skull: The orbits face upward and slightly forward. They are almost twice as long as wide and differ in shape from those in *Prodiplocynodon*. The inner margins are rounded, the outer boundaries are concave laterad in the posterior parts of the orbits, convex in the anterior portions (text-fig. 1). In front the orbits are considerably pointed.

The supratemporal fenestrae are almost perfectly circular. They are moderately far apart and their margins are somewhat elevated medially. The lower temporal vacuities are relatively large, and particularly long. As previously stated, they are posteriorly framed by the quadrato-jugals and the quadrates.

The external nasal opening is not totally preserved. The portion present resembles very much that of *Prodiplocynodon* except that the nasal elements do not enter the opening in *Brachyuranochampsia*.

Nothing can be said about the premaxillary foramen. As shown here (text-fig. 1), it was reconstructed after *Prodiplocynodon langi* Mook. The shape of the palatine fenestrae seems to be very similar to that in *Prodiplocynodon*. The openings are large; anteriorly they reach to a point opposite maxillary teeth number nine.

The internal narial aperture is relatively large, its anterior border lies at about mid-length of the pterygoids, a position quite similar to that in *Leidyosuchus sternbergii* Gilmore.

COMPARISON OF BRACHYURANOCHAMPSA WITH RECENT CROCODILIANS

In a series of extensive studies on the morphology of the skull of recent crocodilians, Kälin (1931, 1933, 1936) distinguishes two families: the Gavialidae and the Crocodilidae. The latter group was subdivided into the subfamilies: Alligatorinae and Crocodilinae. Kälin's characterization of the two subfamilies (*op. cit.* 1933) leaves no doubt that *Brachyuranochamps*a belongs to the Crocodilinae. Among the recent forms of true crocodiles, the new fossil resembles most closely *Tomistoma schlegeli*, if one disregards the enormously elongated snout of the latter. The two forms seem to resemble one another in a number of features which appear to be typical for *Tomistoma* among the recent crocodilians, such as the shape of the orbits and that of the palatine vacuities, the long, posterior premaxillary processes in the roof of the snout and, most conspicuous of all, the shape of the palatines and the development of the palato-maxillary suture. It is doubtful, but not altogether impossible, that *Brachyuranochamps*a actually belongs to the general "Formenkreis" of *Tomistoma*. The fact that the fossil is distinctly short-snouted should be of no concern in this connection since the genus *Gavialis*, too, contains long-snouted and short-snouted forms (*Gavialis gangeticus* Gmelin and *G. breviceps* Pilgrim).

One of the chief similarities between *Tomistoma* and *Gavialis* is the participation of the splenialia in forming the symphysis. Kälin (1936) suggests the possibility that *Tomistoma* might have originated directly from the older opistochoan crocodiles (*Leidyosuchus*, *Brachychamps*a) in which the splenialia quite generally take part in the formation of the symphysis. Since this feature is not known in *Brachyuranochamps*a, more complete specimens may be necessary to decide upon the validity of the present assumption of a closer genetic relationship of this form with *Tomistoma*.

TABLE OF MEASUREMENTS

Greatest width between quadrato-jugals.....	219	mm.
Width at basis of snout.....	164	mm.
Width at level of 5th maxillary teeth.....	104	mm.
Width at maxillary-premaxillary notch.....	54	mm.
Greatest width of premaxillary region.....	75	mm.
Width between anterior tips of orbits.....	64.5	mm.
Narrowest point of interorbital plate.....	26	mm.
Anterior width of cranial table.....	106	mm.
Posterior width of cranial table.....	126	mm.
Narrowest point between supratemporal fossae.....	13.5	mm.
Greatest width of supratemporal fossa.....	34.5	mm.
Greatest width of orbits.....	35	mm.
Greatest width of external narial opening.....	29	mm.
Narrowest point between palatine vacuities.....	26	mm.
Width between anterior tips of palatine vacuities.....	69.5	mm.
Width of internal narial aperture.....	18.5	mm.
Length, occipital condyle to tip of snout (estimated).....	390	mm.
Length, posterior border of cranial table to tip of snout (est.).....	365	mm.
Length, posterior border of cranial table to posterior rim of external nasal opening.....	313	mm.
Length, posterior border of cranial table to premaxillary notch.....	294	mm.
Length, posterior border of cranial table to basis of snout (level of anterior rims of orbits).....	125	mm.
Length between anterior tip of orbit and deepest saddle point of quad- ratal joint surface.....	189	mm.
Length of orbit.....	65	mm.
Length of supratemporal fenestra.....	36	mm.
Length of palatine fenestrae (approximately).....	120	mm.

REFERENCES

GILMORE, CHARLES W.

1910. *Leidyosuchus sternbergii*, a new species of crocodile from the Ceratops beds of Wyoming. *Proc. U. S. Nat. Mus.*, vol. 38, pp. 485-502, pls. 23-29, 2 figs.
1911. A new fossil alligator from the Hell Creek Beds of Montana. *Proc. U. S. Nat. Mus.*, vol. 41, pp. 297-302, pls. 26-27, 1 fig.

KÄLIN, J. A.

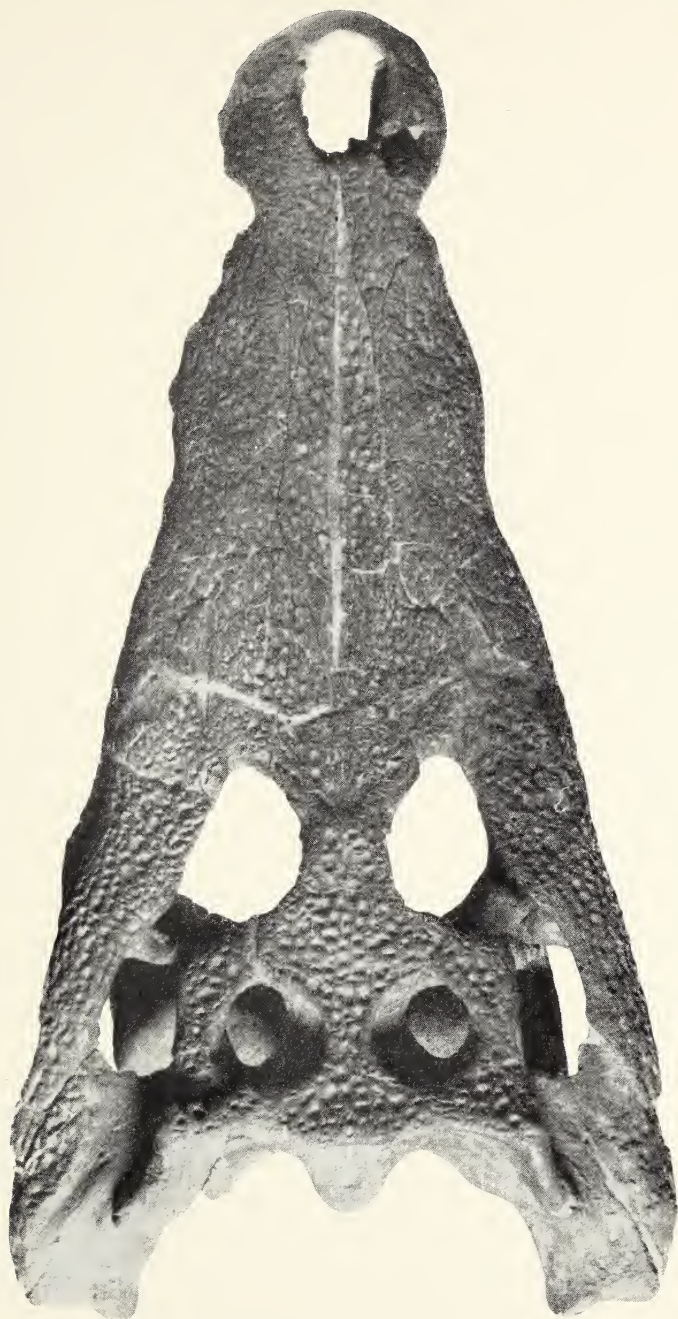
1931. Ueber die Stellung der Gavialiden im System der Crocodilia. *Rev. Suisse Zool. Genève*, vol. 38, pp. 379-388, figs.
1933. Beiträge zur vergleichenden Osteologie des Crocodilidenschädels. *Zool. Jahrb., Jena, Abt. für Anat. und Ontogenie der Tiere*, vol. 57, pp. 535-714, pls. and figs.
1936. *Hispanochampsia mülleri* nov. gen. nov. sp., ein neuer Crocodilide aus dem unteren Oligocaen von Tarrega (Catalonien). *Abh. Schweiz. Pal. Ges.*, vol. 58, p. 1, no. 2, pp. 1-39, pls. and figs.

MOOK, CHARLES C.

1921. Individual and age variations in the skulls of recent crocodilia. *Bull. Amer. Mus. Nat. Hist.*, vol. 44, pp. 51-66, pls. 10-12, 4 figs.
1921. Skull characters of recent Crocodilia, with notes on the affinities of the recent genera. *Loc. cit.*, vol. 44, pp. 123-268, 14 figs.
1941. A new crocodilian from the Lance Formation. [*Prodiplacodon langi*, gen. et sp. nov.] *Amer. Mus. Novitates*, no. 1128, pp. 1-5, 4 figs.

PILGRIM, GUY E.

1912. *Palæontologia Indica*. The Vertebrate fauna of the Gaj series in the Bugti Hills and the Punjab. *Memoirs Geol. Surv. of India*, N.S. vol. 4, no. 2, pp. 1-83, pls. 1-30, 1 map.



Brachyuranochampsus eversolei. Type.
Dorsal view of skull. About two-fifths natural size.



Brachyuranochampsus eversolei. Type.
Ventral view of skull. About two-fifths natural size.



Brachyuranochampsia eversolei. Type.

a. Posterior view of skull.

b. Lateral view of skull, right side.

All figures about two-fifths natural size.



ART. VIII. THE SPINELESS SOFT-SHELLED TURTLE,
AMYDA MUTICA (LE SUEUR), IN PENNSYLVANIA

BY M. GRAHAM NETTING

Atkinson (1901: 154) recorded *Amyda mutica* from Pennsylvania in the following words: "A specimen of this species was taken at Neville Island,¹ May 27, 1899. It must be very rare here." I had always been unwilling to accept this record, for three reasons: (1) the specimen was not preserved, and is, therefore, unavailable for re-determination; (2) no Pittsburgh specimens have come to light subsequently; and (3) the rivers near Pittsburgh have been productive of many exotic creatures, including alligators. Surface (1908: 120) listed *Amyda mutica* as of probable occurrence in Pennsylvania, solely upon grounds of geographic probability—Nash (1906: 17) having recorded a specimen from the Ontario side of Lake Erie. De Sola (1931: 155) stated, "It occurs in the western part of Pennsylvania along Lake Erie," a general statement probably attributable to Nash also. Recently, Nash's record has been considered invalid, and probably due to a misidentification (Logier, 1939: 57). Stejneger and Barbour (1933: 153, and 1939: 171) included "western Pennsylvania" in the range of the species. If I had thought to query either of these latter authors I might have learned earlier what has just been called to my attention by Coleman J. Goin and Roger Conant; namely, that there is an extant Pennsylvania specimen of *Amyda mutica*. Mr. Arthur Loveridge has kindly lent me this turtle for examination. It is MCZ 1911, collected by S. F. Baird in the Allegheny River at Foxburg, Clarion County, Pennsylvania. Although only moderate-sized (carapace length, 166 mm.), the specimen appears typical of *mutica*, for it has the anterior margin of the carapace smoothly rounded and without spines, and has circular nostrils which are not invaded by any projecting ridges from the nasal septum.

The Foxburg specimen cannot be suspected of being an escape, and its collection in the Allegheny River at an early date (Baird died in 1888) supports Dr. Atkinson's record of the species in the Ohio River below

¹ A large island in the Ohio River about five miles northwest (downstream) from the business section of Pittsburgh.

Pittsburgh some decades later. Although these records establish the occurrence of *A. mutica* in western Pennsylvania in the nineteenth century, they do not offer any evidence as to its present status. Consideration of this problem raises three questions, pertinent in nearly every study of the present distribution of an animal along the boundary of its range.

1. Has the collecting been adequate? The only answer to this question, as it relates to aquatic turtles in this state, is an emphatic "No!" No scientific stream survey program has been attempted in Pennsylvania, and herpetologists are notoriously dependent upon ichthyologists and commercial fishermen for good collections of soft-shelled turtles. In spite of inadequate collecting, however, occasional specimens of *A. spinifera* are secured in western Pennsylvania streams, and if *mutica* is coexistent in these waters it must be less numerous.

2. What natural barriers operated to limit the range of the species prior to human interference? Cahn (1937) states that *mutica* prefers running water, and hence is more frequently encountered in fluvial than in lacustrine habitats; whereas *spinifera* is essentially an inhabitant of quiet waters, either streams or lakes. Both species, of course, favor soft, sandy or muddy bottoms, and clear water devoid of vegetation. Except for short egg-laying excursions, *mutica* is rarely seen out of the water; whereas *spinifera* basks in the sun on convenient shores or logs with considerable frequency. More frequent emergence from the water, and less dependence on running water must give *spinifera* a definite migratory advantage in poorly drained regions where lakes are numerous and low divides may be straddled by swamps. This may explain the absence of *mutica* in the eastern glaciated region where the deposition of till completely upset the previous drainage pattern. The Pennsylvania localities for *mutica*, Foxburg and Neville Island, although in valleys affected by outwashed glacial materials, lie fifteen to thirty miles south of the Illinoian and Wisconsin boundaries, respectively. cursory examination of the maps showing the distribution of *mutica* in Illinois (Cahn, 1937: 179) and Ohio (Conant, 1938: 155) indicates that most, if not all, of the locality records for this turtle in these states lie outside the limits of Wisconsin drift. The extensive lakes associated with the waning of the Wisconsin ice sheet must have provided convenient migration routes for the lake-inhabiting *spinifera*. I am of the opinion, therefore, that *spinifera* reached Lake Champlain, where it still occurs, and the Finger Lakes, Mohawk River and upper Hudson, for which there are nineteenth-century records, in late glacial times. In line with this hypothesis, *spinifera* might have

reached the Finger Lakes during the Lake Iroquois stage,² that is, sometime after the Susquehanna outlet was interrupted, for there is no evidence that *spinifera* ever reached this river. Further extension of the range to the upper Hudson and Lake Champlain may have occurred in very late Iroquois times, after the Champlain Sea had retreated northward, but before the Mohawk outlet was severed.

3. What factors of human occupancy have tended to exterminate relict or peripheral populations, and to result in a contraction of the range of the species? Both species of soft-shelled turtles are equally prized as food, and there appears to be little evidence of differential persecution. Stream pollution, on the other hand, has probably affected the habitats of *mutica* more extensively than it has those of *spinifera*, for rivers and large creeks have undergone the most serious pollution. Furthermore, a stream, depleted of turtles by pollution, might possibly be re-invaded by *spinifera*, following purification; but upstream migration by *mutica* is almost prevented now by the large number of navigational and flood-control dams across our rivers. Pope (1939: 320) and others have reported congregations of *mutica* on the downstream side of dams, and no writer has, to my knowledge, mentioned any similar aggregation on the upstream side—cogent evidence that dams, and probably natural waterfalls, are serious barriers to upstream movements of *mutica*.

It appears safe to conclude that *Amyda mutica* once occurred in the unglaciated portions of western Pennsylvania in the Ohio and Allegheny rivers, that adequate collecting may bring to light relict populations of this turtle in suitable habitats, and that unpolluted stretches of the larger streams, especially below dams, merit particular attention.

² For readily comparable maps of the late stages see Fennemann, Physiography of Eastern United States, fig. 139.

LITERATURE CITED

ATKINSON, DANIEL ARMSTRONG

1901. The reptiles of Allegheny County, Pennsylvania. *Ann. Carnegie Mus.*, 1: 145-157.

CAHN, ALVIN ROBERT

1937. The turtles of Illinois. *Illinois Biol. Monographs*, 16, nos. 1-2: 1-218, pls. 1-31, maps 1-20, text-figs. 1-15.

CONANT, ROGER

1938. The reptiles of Ohio. *Amer. Midland Nat.*, 20, no. 1: 1-200, pls. 1-26, maps 1-38.

DE SOLA, CLARENCE RALPH

1931. The turtles of the northeastern states. *Bull. N. Y. Zool. Soc.*, 34, no. 5: 130-160, figs. 1-19 and I-IV.

LOGIER, EUGENE BERNARD SHELLEY

1939. The reptiles of Ontario. *Royal Ontario Mus. Zool., Handbook no. 4*: 1-63, pls. 1-8.

NASH, C. W.

1906. Batrachians and reptiles of Ontario *in* Check list of the vertebrates of Ontario and catalogue of specimens in the biological section of the Provincial Museum. Batrachians, reptiles, mammals. Dept. of Education, Toronto. 32 p.

POPE, CLIFFORD HILLHOUSE

1939. Turtles of the United States and Canada. xviii+343+v p., 99 photos. New York: Alfred A. Knopf.

STEJNEGER, LEONHARD, AND THOMAS BARBOUR

1933. A check list of North American amphibians and reptiles. 3rd ed., xiv+185 p. Cambridge: Harvard Univ. Press.
1939. A check list of North American amphibians and reptiles. 4th ed., xvi+207 p. Cambridge: Harvard Univ. Press.

SURFACE, HARVEY ADAM

1908. First report on the economic features of turtles of Pennsylvania. Pennsylvania Dept. Agric., *Zool. Bull. Div. Zool.*, 6, nos. 4-5: 106-195, pls. 4-12, figs. 1-16.

RECEIVED TOO LATE FOR CITATION

NETTING, MORRIS GRAHAM

1944. Soft-shelled turtles in Pennsylvania. Biennial Rept. Pa. Board Fish Commissioners, to May 31, 1942: 46-49.

STEJNEGER, LEONHARD

1944. Notes on the American soft-shell turtles with especial reference to *Amyda agassizii*. *Bull. Mus. Comp. Zool.*, 94:1-76, pls. 1-30.

7.73

ART. IX. ADDITIONS TO THE LIST OF MEXICAN
AMPHIBIANS AND REPTILES IN THE CARNEGIE MUSEUM

BY HOBART M. SMITH
UNIVERSITY OF ROCHESTER

In 1939 (Smith, 1939) the Carnegie Museum contained 76 specimens representing 44 species of Mexican amphibians and reptiles. Since then 28 specimens of nine species, all new to the collection, have been added,* to make a total of 104 specimens and 53 species. Through the courtesy of Mr. M. Graham Netting I have been enabled to study this new material and, at his suggestion, to present the following notes on it.

Bufo perplexus Taylor

Bufo perplexus Taylor, Univ. Kans. Sci. Bull., 29, 1943, pp. 347-349, pl. 27, figs. 1, 2.—Mexcala, Guerrero.

Morelos: 5.5 miles west of Alpuyecá, 1 specimen (22,133).

A typical adult female lacking the diagonal lateral light stripes of the related *marmoreus*.

Ctenosaura similis similis (Gray)

Iguana (Ctenosaura) similis Gray, Griffith's Animal Kingdom, 9, synopsis, p. 38.

—Type locality unknown.

Ctenosaura similis similis Barbour and Shreve, Occ. Pap. Boston Soc. Nat. Hist., 8, 1934, p. 197.

Yucatán: Uxmal, 1 specimen (22,755).

A typical, half-grown female measuring 170 mm. from snout to vent.

Phrynosoma asio Cope

Phrynosoma asio Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 178.—Colima.

Colima: Colima, 4 specimens (14,501-4).

Tecomán, 3 specimens (19,268-70).

The sex, femoral pores, total length and tail length of these specimens, respectively, are: *female*, 7-10, 117 mm., 61 mm.; *male*, 9-10, 104 mm., 73 mm.; *female*, 9-9, 107 mm., 62 mm.; *female*, 8-9, 109.5 mm., 64 mm.; *female*, 9-9, 122 mm.?²; *female*, 9-10, 116 mm., 71 mm.; and *female*, 7-8, 119 mm., 66 mm.

The tail is markedly longer in the male, although all the females have a

*Specimens bearing the numbers 22,755-22,772 were donated by Dr. Robert H. McCauley, Jr., to whom the Carnegie Museum is again indebted for welcome additions to its collections.



total greater snout-vent length. The pores number a little higher than is recorded for southern specimens (Guerrero and Oaxaca).

***Cnemidophorus deppii deppii* Wiegmann**

Cnemidophorus deppii Wiegmann, Herp. Mex., 1834, p. 29.—Tehuantepec, Oaxaca.

Cnemidophorus deppii deppii Cope, Trans. Amer. Philos. Soc., 17, 1892, p. 31.

Guerrero: Acapulco, 13 specimens (22,759-71).

Although the specimens of this series are rather small (the largest measuring only 60 mm. from snout to vent), for which reason the pattern is of little aid in identification, they appear, on the basis of other characters, to belong to the typical race rather than to *C. d. lineatissimus*, which occurs in the Rio Balsas basin at least as far inland as the town of Balsas (Smith, 1939: 25-26).

The preanal rows average 4 (4, nine; 5, four); the femoral pores vary from 16 to 19, average 17.5 (16, two; 17, ten; 18, eight; 19, one); circum-orbital scales 5 to 11, average 7 (5, three; 6, seven; 7, ten; 8, three; 9, one; 10, none; 11, two*); granular scales between superciliaries and supraoculars in a single row in five specimens, in two complete rows both sides in two and on one side in three, and in two incomplete rows in the remainder; lamellae on the 4th toe, 29 to 34, average 30.8 (29, six; 30, three; 31, eight; 32, seven; 33, none; 34, one); anterior subocular (frenocular) in contact with loreal on both sides in one, on one side in three, preoculars 1-1 in six, 1-2 in three, 2-2 in four.

The femoral pores are intermediate between the expected counts of *d. deppii* (average 19) and *d. lineatissimus* (average 16.5). The circum-orbitals are likewise intermediate (average 5 in *d. deppii*, 8 in *d. lineatissimus*). The number of preoculars, the contact or separation of the loreal and anterior subocular, the number of lamellae on the fourth toe and the number of rows of granules between the superciliaries and supraoculars are characters that are not known to be of importance in separating the two subspecies. The number of rows of preanals, however, is not known to be less than 6 in *d. lineatissimus*, but in *d. deppii* it varies from 4 to 8 (average 6), the Acapulco specimens are thus entirely within the range of *d. deppii*; the juvenile males, moreover, appear to be blackish (instead of blue) on the abdomen, thus agreeing more closely with *d. deppii*.

In the absence of a series of adults and of definite determination of the subspecies in the immediate environs of Acapulco, it seems preferable to accept the only fairly definite indications available, and regard the

*These two counts occur in a single specimen, in which the posterior three supraoculars are completely separated from the median head scales by the circum-orbitals.

Acapulco population as representative of *d. deppei*, although perhaps intermediate in character. Balsas, where *d. lineatissimus* occurs, is not over 75 miles away from Acapulco, yet the faunas of the two localities show many differences; for that reason the distinction between the populations of *C. deppei* in the two localities is not without zoögeographic justification.

***Ficimia olivacea streckeri* Taylor**

Ficimia streckeri Taylor, Copeia, 1931, pp. 5-7.—Three miles east of Rio Grande City, Texas.

Ficimia olivacea streckeri Smith, Zool. Ser., Field Mus. Nat. Hist., 29, 1944, p. 139.

Nuevo León: Monterrey, 1 specimen (22,772).

This is the fifth recorded specimen from México, and the second from the state of Nuevo León. It adds little to previous knowledge of the geographic range of the subspecies, but its ventral count is unusual. The specimen is an adult female measuring 333 mm. in total length, of which the tail comprises 50 mm. The ventrals number $137\frac{1}{2}$, caudals 30, supralabials 7-7, infralabials 8-8, preoculars and postoculars 1-1, and internasals 0-0. The dark cross-bands are narrow and well-defined, as is typical of this race, and number about 42 on the body, and 11 on the tail.

The ventral count of this specimen is $5\frac{1}{2}$ lower than the minimum previously recorded for some 15 females; the total known range in this sex is $137\frac{1}{2}$ to 150 (*cf.* Mulaik and Mulaik).

No deviation whatever toward *F. o. olivacea* is apparent in this specimen; intergradation between the two races probably does not occur north of the Tropic of Cancer.

***Conophis vittatus vittatus* Peters**

Conophis vittatus Peters, Monatsb. Akad. Wiss. Berlin, 1860, pp. 519-520.—Type locality unknown ("New Orleans").

Conophis vittatus vittatus Smith, Journ. Wash. Acad. Sci., 31, 1941, pp. 119-120.

Guerrero: Acapulco, 2 specimens (22,757-8).

Only about twenty specimens of this race are known. These two are adults, measuring 469 mm. and 482 mm. in total length, respectively; the tails measure 92 mm. (♀) and 106 mm. (♂) respectively. Respectively the ventrals are 159, 154; caudals 62, 67; supralabials 7-7; infralabials 10-11, 9-10; preoculars 1-1; postoculars 2-2; temporals 1-2, 2-2-3; scale rows 19-19-17 (19), 19-19-17. The patterns are typical.

The specimens were found "under drift wood on beach sand." The stomach of the female contained two specimens of *Cnemidophorus d. deppei*, a species of lizard very common at that locality.

Bothrops yucatanicus (Smith)

Trimeresurus yucatanicus Smith, Zoologica, 26, 1941, pp. 62-63.—Chichen Itzá, Yucatán.

Yucatán: Chichen Itzá, 1 specimen (22,756).

This juvenile topotype is the fifth recorded specimen and the fourth from México; Schmidt (1941) records it from British Honduras. It is a male with 25-25-21 scale rows; ventrals 148; caudals 40, all entire; supralabials 9-9; infralabials 11-11; total length 197 mm., tail 24 mm. (these measurements in life were 210 mm. and 27 mm., respectively). The lower preocular is about three times as large as the middle preocular, but both are excluded from the orbit. The tail tip is pale yellow. In other respects the specimen agrees remarkably well with the description of the type.

Crotalus lucasensis Van Denburgh

Crotalus lucasensis Van Denburgh, Proc. Calif. Acad. Sci., Ser. 4, 10, 1920, p. 29 pl. 3, fig. 1.—Agua Caliente, Baja California.

Baja California: Cape San Lucas, 1 specimen (18,522).

A typical adult female (formerly L. M. Klauber No. 20,646).

Crotalus mitchellii mitchellii Cope

Caudisoma mitchellii Cope, Proc. Acad. Nat. Sci. Phila., 13, 1861, p. 293.—Cape San Lucas, Baja California.

Crotalus mitchellii mitchellii Klauber, Trans. San Diego Soc. Nat. Hist., 8, 1936, p. 154, map, fig. 1, pl. 19, fig. 1.

Baja California: Cape San Lucas, 1 specimen (18,523).

A typical adult female (formerly L. M. Klauber No. 22,678).

REFERENCES

- MULAİK, STANLEY, AND DOROTHEA MULAİK
1943. Observations on *Ficimia streckeri* Taylor. Amer. Midl. Nat., 29: 796-797.
- SCHMIDT, KARL P.
1941. The amphibians and reptiles of British Honduras. Zool. Ser. Field Mus. Nat. Hist., 22: 475-510, fig. 38.
- SMITH, HOBART M.
1939. Notes on Mexican reptiles and amphibians. Zool. Ser. Field Mus. Nat. Hist., 24: 15-35.
1939. An annotated list of the Mexican amphibians and reptiles in the Carnegie Museum. Ann. Carn. Mus., 27: 311-320.

07,73
4P6842



ART. X. A SECOND SPECIMEN OF AN AFRICAN BAT,
PLEROTES ANCHIETAE (SEABRA)

BY GLOVER M. ALLEN
MUSEUM OF COMPARATIVE ZOOLOGY

INTRODUCTORY NOTE

In the spring of 1935 I sent a number of African bats to Dr. Glover M. Allen for study. During the course of his examination he found several interesting specimens, but he was particularly delighted with the specimen of *Plerotes*, Carnegie Museum catalogue number 6,971. He wrote me, under date of June 19, 1935, suggesting that a note concerning this specimen would be desirable. I felt, however, that the note should be written by him, so in reply to his letter I said that, since he was an authority on Chiroptera, a note bearing his name would be much more valuable. He prepared the following account, but under the pressure of other work it was evidently lost or laid aside. Some time after his death his associate, Miss Barbara Lawrence, discovered the note while going through his papers. She recognized its significance, and, having no record of its publication, sent it to me. I, too, was unable to find any record of its having been published, and suggested that, unless she had some other thought on the matter, it could appear in the Annals of the Carnegie Museum. With her permission, therefore, the article appears below as Dr. Allen wrote it. We are indebted to Miss Ruth Lang, of the Carnegie Museum, for the illustrations which accompany the article.

J. KENNETH DOUTT

Dr. Allen's account of the second specimen of *Plerotes anchietae* (Seabra)

In 1898 A. F. de Seabra briefly described, and figured the palate ridges of, a small fruit bat from Galanga, Benguela, Angola, as "*Epomophorus* n. sp.," and two years later named it *Epomophorus anchietae* in honor of its collector, who from time to time secured so many West African species of mammals. The type and only known specimen is a female, mounted, but with the skull extracted, in the Lisbon Museum, Portugal. When Knud Andersen studied the specimen in 1910, he made it the type of a distinct genus, *Plerotes* (Ann. Mag. Nat. Hist., ser. 8, vol. 5: p. 97, 1910), pointing out the interesting fact that it parallels in the subfamily Epomo-

MAY 15 45

phorinae the small members of the Macroglossinae, in its weak and very much narrowed teeth, and hence is probably like them a flower and nectar feeder. A full account of the characters of the female type specimen is given in his Catalogue of the Chiroptera in the British Museum (vol. 1, p. 483f, 1912), in which he adds that up to March 1910, no second specimen had turned up and the characters of the male remained unknown. I have therefore thought it worthwhile to record, with the kind permission of Mr. J. Kenneth Doult, Curator of Mammals in the Carnegie Museum, Pittsburgh, a specimen in the collection under his charge which he has submitted to me for identification. It is an adult female, although labeled a male, no. 6,971, from the Malange district, Angola, taken at

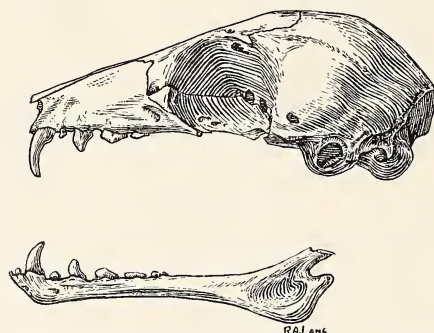


FIG. 1. Side view of skull and mandible of *Plerotes anchietae* (Seabra); Carnegie Museum, no. 6,971.

Chitau, 4900 feet, January 12, 1931, by R. and L. Boulton of the Pulitzer Angola Expedition. In color, it is uniformly drab-brown above, and a much paler drab below, the two surfaces contrasting rather strongly. The fur of the body extends out on the forearm half-way to the carpus, and along the outer side of the radius to the third quarter of the forearm on both dorsal and ventral sides, and similarly on the proximal two-thirds of the propatagium. As in other Epomophorine bats, there is a small tuft of white hair at the antero-internal base of the ear and a larger one at the postero-external border. A rather sharp line of demarcation running forward from the insertion of the wing to the lower cheek separates the color of the back from that of the ventral side, but although the hair just below the edge of the propatagium is distinctly whitish, there is no marked tuft to indicate the presence of a humeral gland. The backs of the hind feet are heavily furred quite to the base of the toes, with a line of brown

hairs along the back of each toe to the claw. A striking feature is the extremely narrow interfemoral membrane, which is almost completely hidden by the long fur of the rump, and extends on each side from about the level of the lower femur to the heel, without, however, an obvious calcaneum. The skull of this specimen agrees closely with Andersen's description except that the minute last lower molar (M_3) which was present in the type, is quite lacking on both sides, without even a trace of an alveolus. While the soft parts remain unknown, it seems likely that the broad

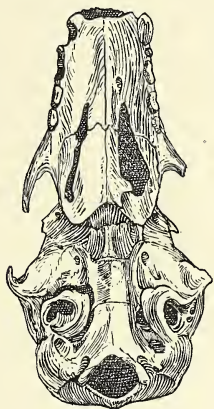


FIG. 2. Ventral view.



FIG. 3. Dorsal view.

Skull of *Plerotes anchietae* (Seabra); Carnegie Museum, no. 6,971.

palate and anterior space between the canines, as well as the reduced lower incisors, indicate an extensile tongue for nectar feeding. The forearm of the specimen, measured on the skin, is only 47.5 mm., against 53 in the type. The collector's measurements as entered on the label are: total length, 87 mm.; tail, 0; hind foot, 19; ear, 17; wing spread, 343.

AP6842





Mounted specimen of the Roseate Spoonbill, incidentally one of the few colored illustrations ever made of this bird. Reproduced from a print enlarged from a wet collodion plate made by Webster about 1870.

ART. XI. THE BIRTH OF HABITAT BIRD GROUPS,

REMINISCENCES WRITTEN IN HIS NINETY-FIFTH YEAR,

BY FREDERIC S. WEBSTER

PREPARATOR-IN-CHIEF, CARNEGIE MUSEUM, 1897-1908

(PLATES I-XI)

INTRODUCTORY NOTE

The beautiful habitat groups of the great natural history museums of today are the result of much pioneering and of long development. The following account by Frederic S. Webster tells of his own early concepts and experiments which resulted in his construction of what well may be considered the first forerunners of the present museum masterpieces of wildlife in its native environment. The ranking bird taxidermist of his time, Mr. Webster, as early as 1869, had produced and sold stereoscopic pictures of realistic groups of birds and small mammals which he had mounted amongst lifelike accessories from the field and forest. To enhance the realism of his stereoscopes he conceived and used flat and later semicircular painted backgrounds. The group of three African flamingos, "The Flamingo at Home," mounted by him in 1880, and still on exhibition in the Milwaukee Public Museum, is known as the pioneer bird group of America.

Mr. Webster devised and gave to bird taxidermists the still-used excelsior egg-shaped manikin body, an idea that William T. Hornaday, with the addition of a soft clay covering, later adapted to the mounting of large mammals and which continued in use until Carl Akeley evolved his hollow papier-mâché form. One of Mr. Webster's early preparations was a mounted skin and an articulated skeleton from the same individual, the first specimens thus treated being an American Jabiru for Harvard and an Humboldt's monkey for the National Museum.

For twelve years he was chief preparator of Carnegie Museum and later ornithologist for the City of Pittsburgh. I was one of those who came to know and admire him and his skillful preparations when he was with the Carnegie Museum. In 1901, he and Mr. James C. Rea and I made a memorable visit to Europe. The Carnegie's Scotch Grouse and African Hornbill groups were resultants of this trip.

The following account written by Mr. Webster, who is still a dynamic worker in his ninety-sixth year, reminisces of his early days, ideas, and struggles. (Childs Frick)

Nature is always very real and most everything else artificial and more or less meaningless. Life, with all its romance, comedy, and tragedy, is but a fleeting spirit that climbs in the window and then tiptoes out the backdoor.

In the late evening of my ninety-fifth year, as an inspiration to others who have to make their battle, I would venture to tell of the contrasts of the early morning of my youth. It is not altogether a simple undertaking in the twilight. Governed by the statute of limitations it calls for speed, good will and an active memory. Every person connected with this tale and millions more now are dead.

NEW YORK JUST AFTER THE CIVIL WAR

The atmospheric and environmental influences, imbibed at the time of which I am writing, were strange, disturbing and tragic in the extreme. The Civil War of 1860 to 1865 had just closed. The martyred Lincoln had been assassinated by John Wilkes Booth, the actor, who was being hunted with a vengeance, hither and yon. The first Memorial had been observed. The parade of wagons filled with flowers of every description passed down Broadway by the street where I was employed. There were no bands, everything was as deeply silent as death itself.

Charles Darwin had written his "ANIMALS AND PLANTS UNDER DOMESTICATION" and a little later, his "ORIGIN OF SPECIES" that had set people wondering if he would be jailed. The puritan spirit, lost in the mists of modern teaching, was still a strong factor to keep people steadfast to principle.

It is unfortunate that the personal pronoun "I" has to appear so frequently, but as this is a personal effusion it cannot be avoided. In 1867 I had left a law office, to be employed as a bank runner and mailing clerk in the wholesale drygoods firm of William I. Peake & Company, a vigorous rival of H. B. Claflin & Co., A. T. Stewart & Co., and George Bliss & Co. The sales of the Peake house for one year amounted to eight millions of dollars. I banked a large portion of that enormous sum and in addition drew seven thousand and five hundred dollars every two weeks to meet the payroll for the many employees. Many nights during the fall and winter I worked so late that no cars of the three existing horse-car lines were running and I had to walk the three miles home. After serving for three years, for six days in the week from eleven to twelve hours daily, I broke down completely and was compelled to give up my ten dollar a week position.

At that time there were no trolley cars, no elevated railroads, no subways, no telephones, and no electric lighting. Electricity was a "wild dream" and in no way utilized. The city had gas-lamp posts standing at street corners, but only in the better sections. Two of these lamps I lit while delivering the evening newspaper during the first summer of the war.

Snow lay in the streets until it melted. If permitted to lay now as it did then, the perils of life in big cities would soon reduce them to half their population. Central Park was very far away and in the spring and winter, when there was skating, the Third and Eighth Avenue car lines announced the fact by flying a good-sized muslin flag, with a big red ball painted in the center, from a staff on the top of the cars. There were no motion pictures and no radio. The adorable peanut alone filled the yawning maw. Barnum's Museum on the corner of Broadway and Ann Street was the one place where the "upper ten and the lower twenty" could meet and mingle with equanimity. There was no football, but there was baseball far away on the Elysian Fields in Weehawken, N. J., near the monument marking the place where Alexander Hamilton, the revolutionary patriot, was shot in a duel with Aaron Burr in 1804.

Everything was based on horse power, the friend which carried mankind up on its stormy way and as its reward has been the most abused creature that ever existed. There was no Humane Society. Mr. Berg had not come into the picture to end abuse of the faithful animal. Keep in mind that the picture being painted is principally centered in New York City. The Indian tribes and the buffalo were supreme beyond Chicago; Los Angeles was a scattered hamlet where men won their spurs on horseback with a gun.

In those days colored people were not permitted to ride on street cars except for two cars of the Sixth Avenue line. These cars had a foot-wide white panel above the windows, running the entire length of the car, on which was painted in large black block letters, "Colored People Allowed On This Car." These same cars were literally torn to pieces and thrown into the gutters by rioting mobs during the draft riots.

The sons of the Emerald Isle were the chief laborers and many "ads" for service in the newspapers of the day had in smaller lettering at the bottom "No Irish need apply." Tammany Hall was organized by this powerful working group and constitutes the Democratic Party of this day. They were fighters. The old "69th" regiment made a great name in the Civil War and a lasting record for the nation.

There were no steam fire-engines and property often was left to burn because the man-powered fire truck could not get there fast enough. These trucks were pulled by a long double rope which could be unwound as men and boys, gathered along the way, volunteered to help. The two tall fire-tower bells rang out only the ward where the fire was located so the fire had to have a good start and to be bright enough to show where

it was located. While the "Old Hickory Engine Truck" was identified with the Irish Democrats, the "Chelsea Hook and Ladder Company" was composed of Republican aristocrats. The chief object of both crews was to see who could get to the fire first. When both arrived together, a high powered fist fight usually took place while they left the fire to crack on and gut the building, to the joy of the hilarious rabble that swarmed the street and carried off the contents. If a fire started in a block of houses having party walls, usually three houses were wrecked.

FIRST HABITAT GROUPS

The American Museum of Natural History was non-existent, except as a society of natural history of which the first Theodore Roosevelt was Secretary. This society had a modest collection in the Old Arsenal building in Central Park.

When I left the William I. Peake Company in 1867, something had to be done to restore my wasted strength which had been greatly impaired under the conditions over which I had had little, if any, control. It was the great out-of-doors that I needed and wanted. I went to Troy, N. Y., to visit my aunts and cousins, some of whom I had never seen. There I came to know that to which I desired to devote my life; namely to reproducing truthfully the beauty of nature, and the future became very definite as far as I could see and feel at the time.

In Troy I was received by the family of my cousin, Frederic A. Lester, with wide-open arms, and for nine too-fast fleeting years Fred and I roamed the countryside with our old pointer "Sport." For a few years we hunted and fished so much that we earned the disapproval of our relatives for loafing away so much valuable time. It was in this home in 1868 that I first conceived the idea of museum "habitat" groups. My interest had first been caught and my imagination stirred by a few small birds which my cousin had mounted. Fred eventually took up the study of law while I continued in my plenary purpose. My only encouragement came from my cousin's sister who inspired me to keep on toiling. In the end I managed to develop a nice "nest egg" through my skill and artistic preparations.

Owing to my consummatory feelings for nature in every respect, the deep magic proceeding from the voices of the birds, the swish of the sea, the moaning of the forest, the crashing of the lightning, and the growing realization of the spirit and power of an omnipotent force, it was not difficult for me to appreciate the high value and stirring appeal that



Group of the Least Bittern, assembled around 1870 by Webster and photographed then by him on wet collodion plates for his stereoscopic pictures. Reproduced from a colored enlargement made from the original plate.
(To face page 100)

habitat groups would bring to the museums of a great city, and the forceful and stimulating educational factor that they might become to city toilers cut off from nature and the out-of-doors.

Through stereoscopic picture cards of animate life which I began to produce for school and family use, it was not very long before I had made a reputation and secured many admirers. One of these was the Hon. George B. Warren, an early friend of Audubon. He had wealth, influence, a fine collection of mounted birds, and a splendid library. Among its volumes those of Audubon particularly fascinated me. I was the only person permitted to remove one of those volumes from his large stone dwelling and keep it until I was through with it. For six years I was never without a bird book to refer to. Mr. Warren was past seventy and my youthful enthusiasm in the direction in which he was interested afforded him endless pleasure. Many an oyster roast had we, in his parlor-like kitchen, while discussing birds and nature to our heart's delight. He had the only specimen of the extinct Labrador Duck I ever saw outside of the American Museum of Natural History.

As time went on, and in spite of many difficulties such as the lack of good health, a proper place in which to work, and the absence of proper materials, long hard efforts resulted in the accomplishment of my ambition. My "sets" often took from six to eight feet of space. All green materials were gathered on Saturday before the Sunday on which the group had to be reassembled and photographed. The natural materials, regardless of size, were collected whenever possible near the spot where the birds had been shot. The work had to be done in the summer when there was a certainty of a suitable light streaming into all parts of the various sets. These were arranged in my studio gallery beneath the glass skylight on the top of a four story building. A large water pan that had to be made for the group of the Great Northern Diver gave me endless trouble. All the cumbersome impedimenta had to be gauged and measured before cutting. Electric elevators were not then known. There was a narrow winding stair, having a narrow tread and a high rise, which with sprawling branches and easily injured leaves and other green accessories "was something to negotiate." When the "set" was ready to be photographed, if the sunlight failed it was "just too bad," as payment for the use of the gallery was expected to be met just the same. This very unpleasant experience happened in the case of the Great Northern Diver, the Pileated Woodpecker and the Black-crowned Night Heron. A few of the smaller "sets" also resulted in many difficulties. But I did it all

single handed, ever striving to be true to nature and to attain perfection.

While "dwelling on the mountain tops" and making these group-sets for my stereoscopic pictures, some of which are here illustrated, a friend of the editor of the "Troy Times" called the attention of George B. Sennett of Erie, Pa., to my pictures. They told their own story to Mr. Sennett, who was arranging for a collecting trip to the lower Rio Grande and to Mexico, and he induced me to accompany him with expenses paid but without salary. This was in March 1877—68 years ago (1945). On returning from the Rio Grande border in May, 1877, I stopped for several weeks at Erie, Pa., to mount certain birds for Mr. Sennett's extensive cabinet and to arrange his collection of birds and other specimens. Later, when I was connected with that institution, he donated all his collections to the Carnegie Museum of Pittsburgh. Shortly after returning to Troy, N. Y., Mr. Sennett wrote me asking why I did not write and send some of my 'scope pictures to Ward's Natural Science Establishment at Rochester, N. Y. I had never heard of the latter and had no more idea of what it was like than I had of Timbucktoo. But I did write and send a set of twenty-four of my best colored 'scopes. They were water-color tinted. I had a sharp sense of coloring, as good as my sense of form that has remained with me up to this very day.

WORK AT WARD'S NATURAL SCIENCE ESTABLISHMENT

To my great surprise and even greater satisfaction, three days later, I received a complimentary letter in reply from dear old Professor Henry A. Ward closing with the words, "You may come on at once!" He said that the pictures impressed him more than any others he had ever seen of mounted birds. That was not surprising to me for with my method I was able to make the birds lifelike, frequently an impossibility with the old French wiring method, known as "stuffing."

I did not go to Ward's to acquire a reputation as a taxidermist. That I already had and I was recognized as having ability of an advanced type. Otherwise Prof. Ward would never have sent me the message to hurry on to Rochester and added me to his celebrated staff of fifteen experts, the best the world could produce. Up to that time specimens had been prepared by being stuffed—the larger mammals with straw and the smaller with chopped tow and flax, the stuffing being inserted in the sewn-up skin with "pushers." For birds there was a wire for each wing and for each leg, which was twisted around a central wire sharpened at both ends, one end of which was pushed through the tow-filled skull, and the other

through the tail bones. The central wire had two loops at proper distances through which the wing and leg wires were passed and twisted. You will readily see that by the time these wires were placed and twisted, the tender skin was apt to be out of shape and if not torn it was well weakened and

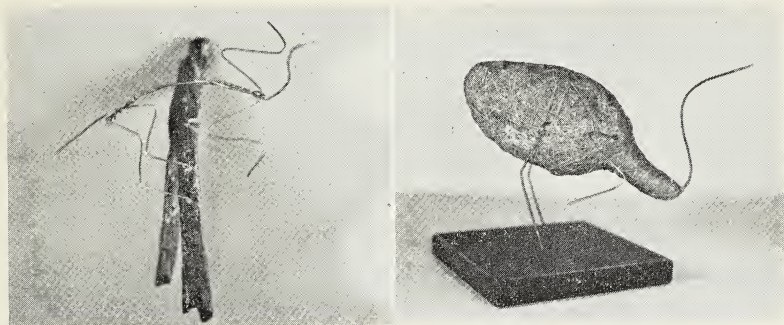


FIG. 1. Left, wire frame on perch, illustrating the old so-called French method, previously in vogue for stuffing birds with a soft filling. Right, excelsior manikin body, devised and first applied by Webster while at Ward's, for use in mounting birds of all sizes.

These methods were first described in print in a "Paper on the placing and winding of birds' feathers, by Frederic S. Webster. With cuts showing good and bad methods." Rochester, N. Y., 8 pages, 1 plate with 5 figures, F. A. Lucas, del. No date, but believed to be 1881.

its feathers mauled. It was no longer the skin of a smooth, sleek bird if indeed it hadn't come close to the point of discard.

To avoid the complications of the old wire frame method, I devised an excelsior body which would enable any preparator to produce a very satisfactory semblance of the original bird even though the skin might be in holes or ripped into a dozen pieces. I have deliberately cut up many skins in order to make a mount and save the bird. Quite a number of wonderful birds of paradise now in the Harvard Museum had to be so treated because the New Guinea natives had dried the skins with hot sand in order to cure them in that humid climate.

In truth, a very good bird mount can be made feather by feather as the curve of every shaft indicates its proper anchorage. The body feathers of nearly all land birds are in strips or narrow rows; one row along each side, one down the center of the back which curves to right and left to meet the rows on the sides, and the neck and belly feathers directly down or up to meet those of the sides.

I soon had everything ready to take my departure and enter upon a business allegiance in a new field of action and service, one which would bring many complications but which in so many ways would be much to my liking and would lead to the happiness of two persons instead of one. I said "adieu" to the loved and devoted folks and to the cherished hospitable home where early triumphs had been won. But alas!

I arrived at Rochester by train at 6:30 o'clock one December morning in the midst of an all-night snowstorm. No cars were running, the streets were deserted and I had to find my way, wading through knee-high snowdrifts for three miles to my destination, Ward's Museum. Unknowingly I passed the cottage-house where the lady lived who later was to become my devoted wedded companion for sixty-five eventful years and who has just passed on at the astonishing age of one hundred years. I found the Wizard of Ward's hard at work in his crowded sanctum. He looked at me, a well groomed lad of twenty-eight, in profound astonishment. I was never to see Professor Ward more ill at ease. The work that I had accomplished and the pictures which I had sent him, had given him the impression that I was a more mature man and for some reason a rough fellow into the bargain. From that moment the Professor seemed to think that I was equal to anything and never hesitated to "pile it on," giving me any sort of a task that no other preparator had ever undertaken, no matter how difficult it might be. I was greatly pleased and always tried my hardest.

I secured a room in a boarding house in the vicinity with a college sophomore who was employed off and on in the establishment and who later studied with Huxley. After a much needed meal I returned to the Professor's office and was taken down to the tangle of the seven shops and laboratories, all of them nearly buried in snow. With some difficulty we entered an unplastered two-storied building that was cold and damp in spite of its "big-bellied" and red-hot coal-burning stove. The three windows, two on one side and one at the front end beside the door, were blanketed with frost. Wet straw littered the floor and filled the place with a pungent stable-like odor. Nothing could have been more forbidding or discouraging than those surroundings. In the center, surrounded by more straw, stood the partly-mounted famous Civil War horse, "Winchester," of General Philip Sheridan. Martens, a taxidermist from Hamburg, Germany, was doing a very creditable job. The method for mounting large mammals in the latter part of the last century was of course crude and had iron-bound limitations. I recalled that cold

December night in 1867 at the old Winter Garden Theater on Broadway, New York, opposite Bond Street, when I heard the immortal tragedian, Edwin Booth, speak those sea-deep lines, "To be or not to be, that is the question" and, as I stood looking at that distressful black horse of General Philip Sheridan, I could not refrain from coining "To think or not to think, that is the question!"

I buttressed my courage as Professor Ward led the way up an open stairway to a better lighted room where a French taxidermist, one of the best men in Europe on birds, was trying to shape a forlorn skin. He sat dazed at the sudden appearance of his "master" with a guest. As we went into a back room we passed a big pile of the most amazing bird skins. I had never dreamed such things existed, Resplendent Trogons, Birds of Paradise, Impeyan, Tragopan and Peacock Pheasants, Scarlet and Bronze Ibises, and innumerable smaller birds from many foreign lands. The mass was piled on the floor and covered the space of an old-time feather-bed. Wings and heads were dangling and legs were missing. The specimens, perhaps two hundred in number, must have cost a large sum. The French taxidermist had tried to mount some of those wonderful birds but had finally decided they were "too far gone." Foreign birds are frequently very difficult to save and prepare because of the climatic and other conditions under which they were collected. These were unmountable only because the man did not have the proper method to apply.

I was fascinated by the enchanting display of a phase of nature of which I was totally unaware and as Professor Ward was moving away I begged him to wait a moment until I could gauge the extent of the damage. Now I have always believed he had not the slightest idea that it was possible for anyone to do what his expert Frenchman could not do and that he was annoyed that I wished to delay over that pile which had been such a grief to him. Nothing was said for a few moments by either of us as I carefully smoothed this skin and that skin with immediate and magical effect. Then suddenly he asked me in a frosty tone, "You haven't any idea *you* can mount those skins?" Not inclined to have my ability questioned I replied simply and very emphatically, "I certainly can!" "Well then," he said, "that's your particular job and begin as soon as possible!" So I started in on those discarded bird skins and in the course of time all but a mere remnant were finely mounted and sent to the Museum of Comparative Zoölogy at Harvard University.

In those days there were no real natural history museums in the sense of today. Institutions of learning had small collections for reference and

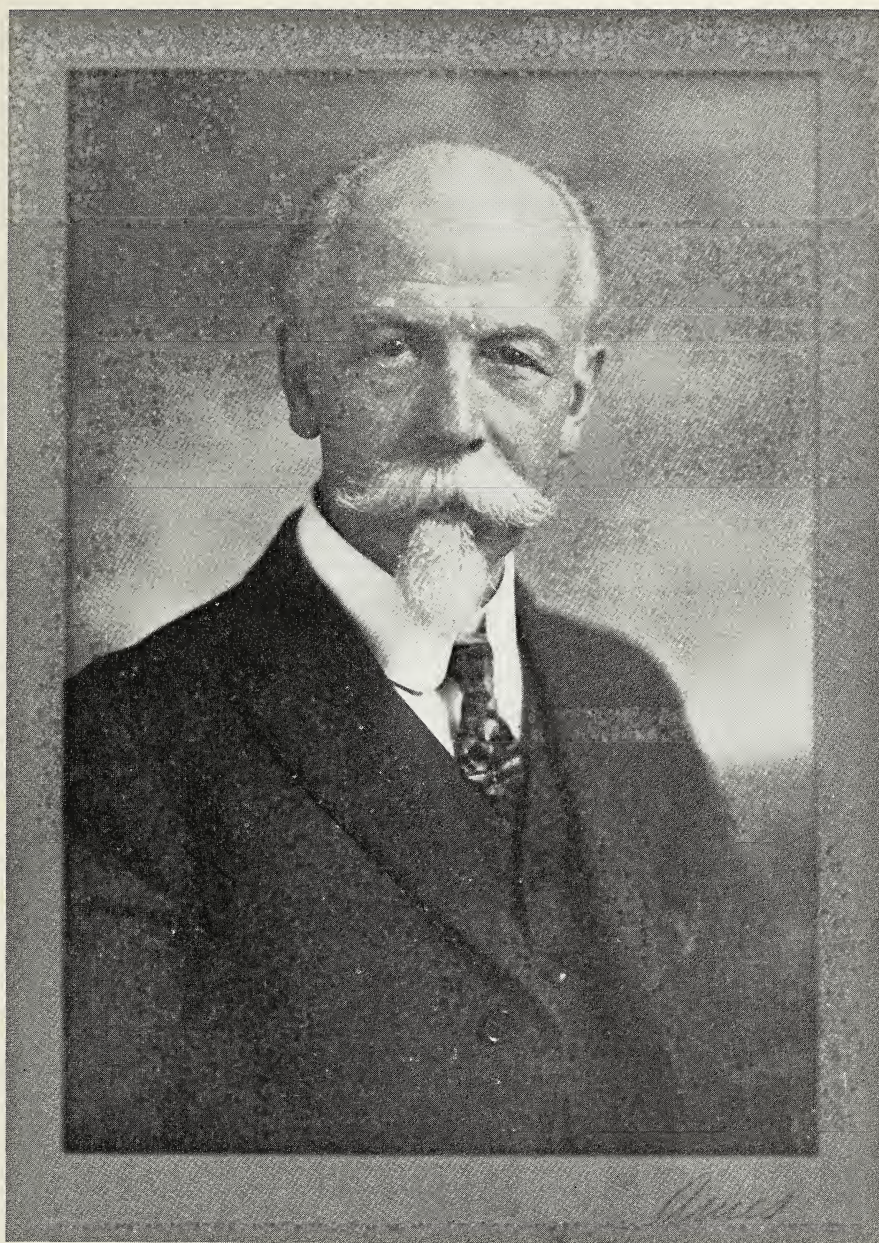
study for the student body, but not for the general public. Professor Henry A. Ward was the first to launch the natural history museum as a public educational factor. He was a geologist by profession and taught that science in the old Rochester University. His scientific establishment was located on a short street, College Avenue, just back of the University. He had a broad vision and used the resources of the rich Ward family to support his magical undertaking. He loved to venture into things considered hazardous. He was one of the world's greatest travelers. Stanley followed his trail in Africa and through the experience of both men Livingstone was located and brought back to civilization.

Ward retained a big staff of workers, all specialists, and gradually was inducing the heads of the larger universities to expand their modest collections of zoological and geological material. It was a herculean undertaking, but he was undaunted and successful beyond expectation. It was not, nor is it today, fully appreciated how much my own humble efforts accelerated the growth and improvement of the work at Ward's and of the resulting museum collections.

Much of my time when I first went to Rochester was devoted to the preparation of material required for the Harvard University Museum. This museum was a memorial to Professor Jean Louis Adolphe Agassiz and was financed by his son, Alexander Agassiz. Dr. J. A. Allen was the Curator.

Amherst University has a hundred American birds I mounted, which originally formed part of Audubon's collection. Mary Audubon sold or gave them to Prof. Ward about the time of my arrival at Rochester. The skins were but a little less than a century old, and before they came into my hands had been considered unmountable. They were largely of water birds and there was much caked fat and many stains which had to be removed.

I had not been at Ward's very long before William T. Hornaday returned from India where he had been collecting animal skins and skeletons principally for the Harvard Museum. We were of about the same age, had similar inclinations, and formed a firm friendship from the very start. He saw what I was doing and had done, and we got our crusading minds together and planned and organized the Society of American Taxidermists. Of this I was President, Hornaday, later to become Director of the New York Zoological Park, was Secretary, and Frederick A. Lucas, later Director of the American Museum of Natural History of New York, was Treasurer.



Photograph of Frederic S. Webster taken in New York in 1918 by the Ames Studio.
(To face page 106)

EXHIBITIONS OF THE SOCIETY OF AMERICAN TAXIDERMISTS

The Society held three interesting and important exhibitions of animal preparations.* The first was held at Rochester, N. Y., in 1880, the second at Boston, Mass., in the following year, and the third in New York in 1883. The last one was under the patronage of Mr. Andrew Carnegie and expenses were borne by him. All three exhibitions had especially prepared displays and these showed a marked improvement each year. Prof. Ward had no particular interest in the various expositions and attended only the one held in Rochester. He did, however, lend Mr. Hornaday's Orang-utan group which had been prepared by the latter while he was on his regular salary.

When I informed Professor Ward that I desired to prepare a group of flamingos for the Exposition he met me with, "Where are you going to get the birds?" "Why, Professor! You have several of them!", I reminded him. "Ho-ho! that's it, is it? Well, you will have to interest me more than I am at the present moment." I had already made a pretentious group of that strange combination of mammal and bird, the Ornithorhynchus or Duck-billed Platypus that lays eggs and suckles its young. Prof. Ward's flamingos were the large African species, *Phoenicopterus antiquorum*, in some respects more beautiful than any other form in their rich pink tints which contrast with the chalk-like white of the rest of the body and the faint rose flush of the long neck. I ventured to ask, "Will you sell me the skins I need—as they are?" "Yes," he said, "I will do that." I immediately paid him the long price of seventy-five dollars for the three fine skins and was happy to have the project fairly launched. The next day to my great surprise he came in to inquire if I had gotten the specimens and as to how

*Regarding the exhibitions held by the Society of American Taxidermists, in an article entitled "Masterpieces of American Taxidermy," which appeared in Scribner's Magazine for July, 1922, W. T. Hornaday wrote, "Three very systematic competitive exhibitions were held. The first was at Rochester, in December, 1880; the second at Boston, in December, 1881; and the third (and last) took its place in history at Lyric Hall, New York, April 30 to May 5, 1883. . . . As one-half the expenses of the New York show, a 'model millionaire' gave the generous and sorely needed sum of five hundred dollars. So far as the writer knows, that was Andrew Carnegie's very first gift to museology. And more than that, Mr. Carnegie actually permitted the society to elect him its treasurer for the year, 1883, by which the society enjoyed the prestige of having a financial backer known to be worth the fabulous sum of fifteen *million* dollars! In view of subsequent occurrences in museum development, we opine that our great and good friend always regarded with satisfaction the outcome of that very hazardous venture."

I intended to assemble the birds in the group. I began telling him what I thought best to do, that I would follow Audubon's description as to the breeding habits of the American bird but that I was not disposed to have the female straddling her nest when incubating, and I went on to describe the general details of the proposed group. When I was through, he said, "I want to know how you know more about the breeding of flamingos than Audubon, and how you are going to fly in the face of such authority?" I reminded the Professor that Audubon had never seen the flamingo breeding and had secured his information from others. Common sense told me that no flamingo could strain its anatomy by resting for hours on the sternum without the support of its legs. No other long-legged bird did and why should the flamingo? He replied, "Well, if you are inclined to make a joker out of such a group I will not let you have the flamingo skins." I had to submit, or give up my dearly treasured plan. Inasmuch as I had yielded the main point of our contention I was able to make a compromise and have him grant me the use of the laboratory in which to prepare the group which I could not have done without that concession. By working overtime on Sundays and nights I was able, without assistance from any one, to complete the group on time for the showing. Prof. Ward smiled his approval.

A few days before the opening, exhibits came in faster than had been hoped for. The amateur work was much better than expected. Mr. Hornaday's "Fight in the tree-tops" showed two big male Orangs, one of them biting off the forefinger of the other. It was all too real to be pleasing to children and sensitive persons but like all gruesome things it attracted attention. Yet it caught the favor of the judges and won the Silver Medal as the best piece in the Exposition—to the surprise of most of the members. As prizes the Society offered a silver medal, a bronze medal, and a number of "diplomas." The bronze medal was bestowed on one of my smaller entries, a very appealing and beautiful Wood Duck which was considered the best mounted bird in the entire exposition and a real classic. The flamingo group was entirely passed over. I had prepared this for a very distinct purpose—to influence Prof. Ward to advance the educational value of museum exhibits by developing habitat bird groups. Up to that time, all animals for museum display were prepared as separate units. Each bird was mounted on a perch facing to the left and in the museum they were set out in the one direction in bewildering rows. Professor G. Brown Goode of the United States National Museum later introduced the systematic labeling of the specimens.

The judges left the city almost immediately after judging the exhibits, without discussing the reasons behind their findings. Dissatisfaction over their decision finally forced the secretary of our society, Mr. Hornaday, to write Prof. W. E. D. Scott, the secretary of the Committee of Judges, asking the reason why they had passed over the Flamingo Group when the chief purpose of the Exposition was to improve the interest and the quality of taxidermy in our museums. The judges' reply was printed in the Princeton press—that while the Flamingo Group showed much skill and artistic merit, the committee considered it an attempt to attain the unattainable, and that exhibits of similar character should be discouraged by scientific institutions. It was thus that these unseeing gentlemen tried to discourage my habitat group idea—the idea that has since been so superbly developed and is now hailed as a grand success by every museum in this “land of saints and sinners.”

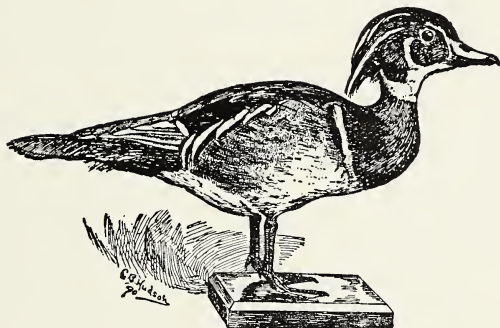


FIG. 2. Wood Duck, mounted by Webster in the conventional older style, reproduced after Hornaday. At the first exhibition of the Society of American Taxidermists held at Rochester in 1880, this single specimen won the bronze medal offered for the second best piece, winning over the new ideas exemplified by the group, “The Flamingo at Home,” shown here in plate VII.

By the time the New York exposition was over, the result was certain and too evident to be denied. I had successfully shown that *visual* natural science had come to stay. My flamingos in popularity had letters and words beaten *two* to *one*. Usually pathfinders do not survive long enough to see the benefits derived from their efforts. I thus have had and still am having the supreme satisfaction of knowing that my humble efforts at colored stereoscopic pictures of animated nature sets, away back in the '60's, and '70's, were the actual forerunners of the superb habitat groups of this day.

When I went to Ward's I had hoped to be able to prepare such groups. My previous "sets" for the "scope" pictures had to be taken down immediately after being photographed and the gallery cleared for Monday's business. The sets were as carefully put together as if they were to be permanent. Several of my twenty-four subjects had painted backgrounds, not very "killing" ones, I'll admit, but in the pictures they afforded the needed perspective and finish.

While on the subject of backgrounds, it may be of interest to record that the first time to my knowledge that a semicircular background was ever utilized, to enhance the realism of a group, was in the case of five "hunting scene" groups that we installed in the Fourth Avenue end of the old Madison Square Garden for the First Sportsman's Exposition when I was Secretary of the Association.

Earnest endeavor, hard work, and ability brought results and landed me in the forefront as a bird preparator almost overnight. For nearly ten years I toiled on without a vacation and produced for Wards a great series of beautifully mounted birds. My revered friend of many years, William Temple Hornaday, in "Masterpieces of American Bird Taxidermy" published in Scribner's Magazine for September, 1925, tells of my services at Ward's:

"In 1878 Professor Henry A. Ward brought to his Rochester establishment a really wonderful bird taxidermist. It is inadequate to describe Mr. Frederic S. Webster by any smaller term. From 1879 to 1882 we worked side by side in the 'large museum' and I now write of what I saw.

"Even at that early time there were in America a score of men who could mount fresh birds exceedingly well, but with old and mummified 'dry skins' their limitations were many. The skill of Ward's foreign taxidermists in dried skins was strictly limited.

"But to Fred Webster ancient bird mummies had no terrors whatever. He received them with outrageous confidence, sometimes tinged with contempt, and sailed through them with a display of cheerfulness, precision and speed that was fairly amazing. His knowledge and skill never missed fire. The small skins he soaked into disreputable masses of wet feathers and bones, mounted them, fluffed them up, and wound them at the rate of from four to eight per day, just like shelling peas. With larger skins that seemed to defy human skill, he was equally successful. . . .

"Now, all this happens to be important history because of the rich fruit that it bore in our American Museums. Thanks to the open-shop spirit created by the unterrified Society of American Taxidermists, eliminating

all desire for secrecy in methods, Mr. Webster taught his processes to a long line of younger men who practiced and passed them along during the remainder of their lives. . . ."

FINIS

EDITOR'S EXPLANATION OF WEBSTER'S STEREOSCOPIC VIEWS

As has been explained in the preceding pages, Webster's first taxidermic work started at Troy, New York, about 1870, when he began to surround mounted birds with natural accessories, including plants, shrubs, tree limbs and natural rocks and earth, for the purpose of producing stereoscopic views of naturalistic habitat bird groups then in wide popular demand. Mr. Webster writes that these photographs, "were originally reproduced in stereoscopic picture cards with notes regarding the birds and their habits printed on the reverse side (see plate IV), and were sold to schools and other interested clients. The stereoscopic view, because of the third dimension, gives a charm that motion pictures do not supply."

Most of the following plates, except where the captions plainly indicate otherwise, have been reproduced from photographs made by Webster of these original assemblages, prepared at the time indicated, for the production of his stereoscopic pictures. They were the forerunners of the modern museum habitat groups in which, however, Webster's natural accessories, trees and grass, have given way to more permanent preparations. The following half-tones have been reproduced from enlargements, made recently by Webster, from the original plates which he made in the 'seventies using the then prevalent collodion or wet process—"the only kind then used by photographers."

In a letter of June 29, 1943, Webster wrote, "I have been trying since Christmas to finish photo prints of some of the taxidermic preparations that I was guilty of seventy-three (73) years ago. . . . They have to be done while I am doing a multiplicity of duties for my wife of sixty-three-years—now one hundred years and eight months old."

Entered according to Act of Congress in the year 1875, by Frederic S. Webster, in the Office of the Librarian of Congress, at Washington.

STEREOSCOPIC VIEWS OF ANIMATED NATURE.

WILSON'S, or ENGLISH SNIPE.

Class II, Order VI, Grallatores. Family Scolopacidae.
Wilson's Snipe. Figure I, Male.

Scolopax gallinago, Wilson's Am. Orn., VI. (1812) 18.
Scolopax Wilsoni, Aud. Orn. Biog., III. (1835) 322; Y. (1839) 583.

DESCRIPTION.

The Wilson Snipe is about 10.1-2 to 11 inches in length, wing 5, tail 2.1-4, bill 2.1-2; tarsus, 1.1-1 inch. Bill long, compressed, flattened and slightly expanded towards the tip, punctulated in its terminal half; wings rather long; legs moderate; tail short; entire upper parts brownish-black; every feather spotted and widely edged with light-rufous, yellowish-brown, or ashy-white, according to age of bird. Back and rump transversely barred and spotted with the same; a line from the base of the bill over the top of the head; throat and neck before, dull reddish-ashy; wing feathers marked with dull brownish-black; other under parts white, with transverse bars of brownish-black on the sides; outer edge of first primary white; tail glossy brownish-black, widely tipped with bright-rufous, paler at the tip, and with a subterminal narrow band of black; outer feathers of tail paler, frequently nearly white, and barred with black throughout their length; bill brown, yellowish at base, and darker towards the end; legs dark-brown; iris hazel; tail consisting of sixteen feathers. The female differs in being more obscure in her colors; the white on the back being less pure, and the black not so deep.

The English Snipe is equally well known, and as great a favorite with sportsmen, as the Woodcock. There is no game-bird so widely distributed over the whole world as the present species. They are found in all countries, from the extreme points of Siberia, to the uttermost limits of the south. The West India Islands, as well as Ceylon, and Japan, are annually visited by this fowl, while the rice plantations of the Carolinas, and the fertile meadows of Egypt alike swarm with their multitudes. Snipes are equally esteemed in all parts of the world where they inhabit, and the richness and delicacy of their flesh may be considered as second alone to that of the Woodcock. The Snipe arrives from the South at about the same time as the Woodcock, and has many of the habits and characteristics of the latter bird. It is found in the Eastern and Middle States only as a spring and autumn visitor, and then passing to higher latitudes to breed. In the spring, while with us, it appears to be pairing, and although associating in small detached flocks, they are most often found in pairs by themselves. It is during this season that the male performs his well-known gyrations in the air. The Snipe lies close to the ground when approached, and being a bird of strong scent, is wounded at a considerable distance by a good dog. The Snipe like the Woodcock, probes in the soft earth for worms and animalcules, which it feeds upon. After its return to us in the autumn, it remains with us until the ground is frozen in the meadows, when it moves to the Southern States, where it passes the winter. The male bird figured, was shot on the 16th day of December, 1874, when the thermometer was nine degrees below zero. The locality was a piece of marshy ground, and at certain places not frozen, being watered from a number of springs near by. The above will at once be seen is a very rare case, as well as an extremely unusual circumstance.

Send Orders to F. S. Webster, Naturalist and Taxidermist, Troy, N. Y.

FIG. 1. Reverse; for other side of this view, see plate opposite.

Entered according to Act of Congress in the year 1876, by Frederic S. Webster, in the Office of the Librarian of Congress, at Washington.

STEREOSCOPIC VIEWS OF ANIMATED NATURE.

AMERICAN WOODCOCK.

Class II, Order VI, Grallatores. Family Scolopacidae.
Figures I, and II, Females. Figure III, Male.

Scolopax minor, Aud. Orn. Biog., III. (1835) 470.
" " Wilson, Am. Orn., VI. (1812) 20.

DESCRIPTION.

Length, about eleven inches; wing, five and a quarter; tail, two and a quarter; Bill 2.1-4; tarsus, one and a quarter. Bill long, compressed, punctulated and corrugated near the end; upper mandible longer than the under, and fitted to it at the tip, wings moderate; tail short; head large, somewhat triangular; eyes fixed high on the head, and a remarkable distance from the bill; occiput with three transverse bands of black, alternating with three others of pale yellowish-rufous; upper parts of the body variegated with pale-ashy, or yellowish red of various shades and black; large space in front of throat, reddish-ashy; line from the eye to the bill, and another on the neck below the eye, brownish black; entire under parts pale rufous, brighter on the sides and under wing coverts; quills ashy brown; tail feathers brownish black, tipped with ashy, darker on the upper surface, and of a silvery white on the under; legs and feet a pale reddish flesh color, iris dark brown. The female is considerably larger, and also differs in having the bill very near three inches in length, and the black of the back is not so intense. Weight from five to eight ounces, and even higher, sometimes as high as ten, and even eleven ounces. The Woodcock is mainly nocturnal in its habits, seldom taking wing in the full light of the day unless disturbed. It walks about, however, and feeds by day as well as by night. Its food is mainly earth-worms, of which it swallows as many in a day as would equal its own weight; and hence its favorite resorts are where it can obtain these worms in abundance. The moist grounds which these birds frequent are perfectly filled with "bill-holes," which they have made in probing for worms, and these holes become a guide to the hunter, who looks at their frequency, and freshness, when he would find good shooting. When flushed by the hunter, or the dog, the Woodcock, ordinarily flies but a short distance, plunging into a clump of bushes or thicket near by, or a thicker part of the swamp. It spends the winter in warm climates, but breeds from the Carolinas to Nova Scotia. The nest, made of dead leaves and grass, is placed under a bush, or beside a fallen trunk. In three or four weeks from the time the young are hatched they are able to fly; and when six weeks old, they fly almost as well as the old ones. In the latter part of July, and during the month of August, while the birds are moulting, they retire to the most secluded localities; and it is difficult to find them at that season. In September, during the continuance of dry weather, they frequent cornfields and ditches; and have been seen searching for worms in the mud in sink-pots, within a few yards of a house. At the latter part of September, and during October, they are in their prime, and it is at this season that they afford the most delightful pleasure to the sportsman.

Send Orders to F. S. Webster, Naturalist and Taxidermist, Troy, N. Y.

FIG. 2. Reverse; for obverse, see plate opposite.

EXAMPLES OF WEBSTER'S STEREOSCOPIC PICTURES

Reduced; the original captions measure $6\frac{3}{8}$ inches in width, and $2\frac{3}{4}$ inches in height, between the crenulated lines.

The production of such stereoscopic views was the motive for the preparation of these early habitat bird groups.



FIG. 1. Wilson's Snipe; front, for reverse, see opposite.

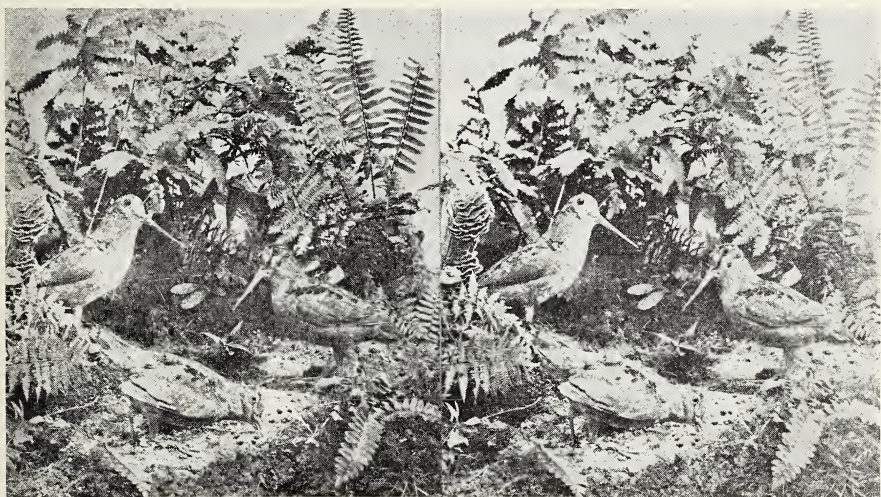


FIG. 2. American Woodcock; obverse, for reverse, see opposite.

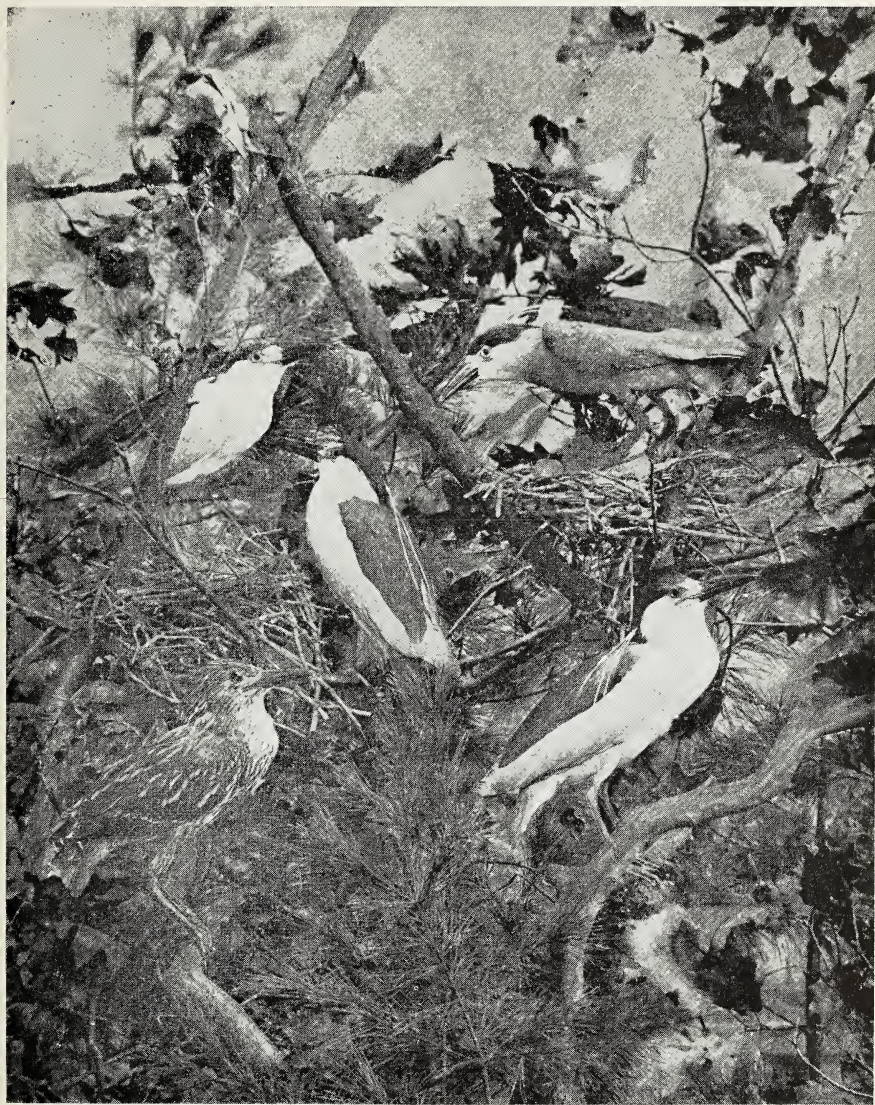
EXAMPLES OF WEBSTER'S STEREOSCOPIC VIEWS

The complete collection included twenty-four pictures, some of which were hand-colored.

EXPLANATION OF PLATE V

From his memory, seventy-three years later, on June 29, 1943, Webster wrote a description of the group of Black-crowned Night Herons, which appears opposite this page. His account follows: "I collected the herons on a rocky island in the Hudson River just below the town of Mechanicsville. There was a large rookery there every year for many years. At the time of breeding, April, the island was safe from invasion as the river tumbled wildly over the ragged rocky bottom, and access was dangerous in the extreme. It was a sure hazard if ventured in a weak skiff. Three visits had to be made in order to get the material for the group which was 6 x 9 feet. It had to be set up in the photographic gallery on Sunday, when the latter was not used for commercial purposes.

"To climb those tall oak trees, get the nests and cut out the clumsy limbs, and transport them down the Hudson River to Troy, was a stunt that no one but a determined youth would think of undertaking, and for no compensation other than ridicule from your family and near friends. I had to mount the birds at home and place them on the limbs, then remove them when taken to the gallery. Speed, care, skill, and enthusiasm did the trick. And now you have the satisfaction of seeing a very perfect reproduction of the breeding habits of the striking Black-crowned Night Heron."



Black-crowned Night Herons, an early habitat group assembled about 1870 with mounted birds, but natural accessories, for the purpose of making a stereoscopic picture card.

EXPLANATION OF PLATE VI

FIG. 1. The author, Frederic S. Webster, in 1870.

FIG. 2. Bronze medal awarded to F. S. Webster at the first exhibition of the Society of American Taxidermists held in Rochester in 1880, for the second best piece, the Wood Duck shown on page 109. Upper figure, obverse, and lower figure, reverse, of the medal.

FIG. 3. Group of the Australian Platypus or Duckbill, mounted by Webster at Ward's Natural Science Establishment in 1879. Reproduced from a woodcut published in Ward's "Science Bulletin." Background redrawn by A. R. Janson and accessories added afterward.



FIG. 1.



FIG. 2.



FIG. 3. The Platypus, mounted in 1879.

EXPLANATION OF PLATE VII

The pioneer bird group of America, consisting of three African Flamingos, entitled "The Flamingo at Home." This was mounted by Webster for the first exhibition of the Society of American Taxidermists held in Rochester in 1880. At the insistence of Prof. H. A. Ward, the female was mounted straddling the nest. To the surprise of everyone, this group was ignored by the judges and the second prize, a bronze medal, was awarded to Webster's individual Wood Duck shown on page 109. The Flamingo Group was subsequently exhibited in the Lyceum of Natural History in the old Arsenal Building in Central Park, New York City, until purchased by the Milwaukee Public Museum where it now stands.

In a letter dated June 12, 1945, W. C. McKern, Director of the Milwaukee Public Museum, wrote as follows: "The flamingo diorama is still on exhibition in this institution. Improvements were made in 1889 and 1903, and the setting was re-cased with an entirely new background in 1939. However, the birds and foreground are substantially the same as they were originally. The posture of at least one of the birds has been changed slightly, but our label still gives Mr. Webster credit for the entire foreground."

Plate reproduced from a photograph of a drawing, originally made by John Ridgway, brother of Robert Ridgway, the ornithologist.



The pioneer bird group of America, mounted in 1880.

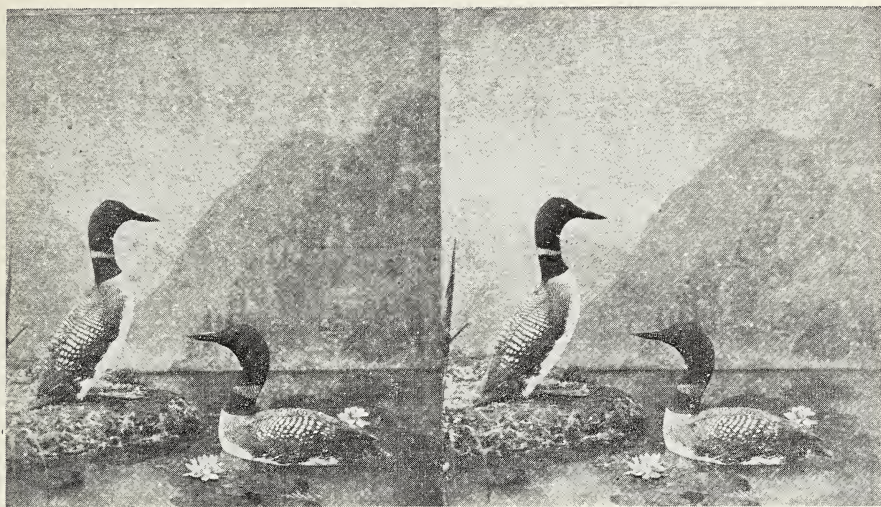
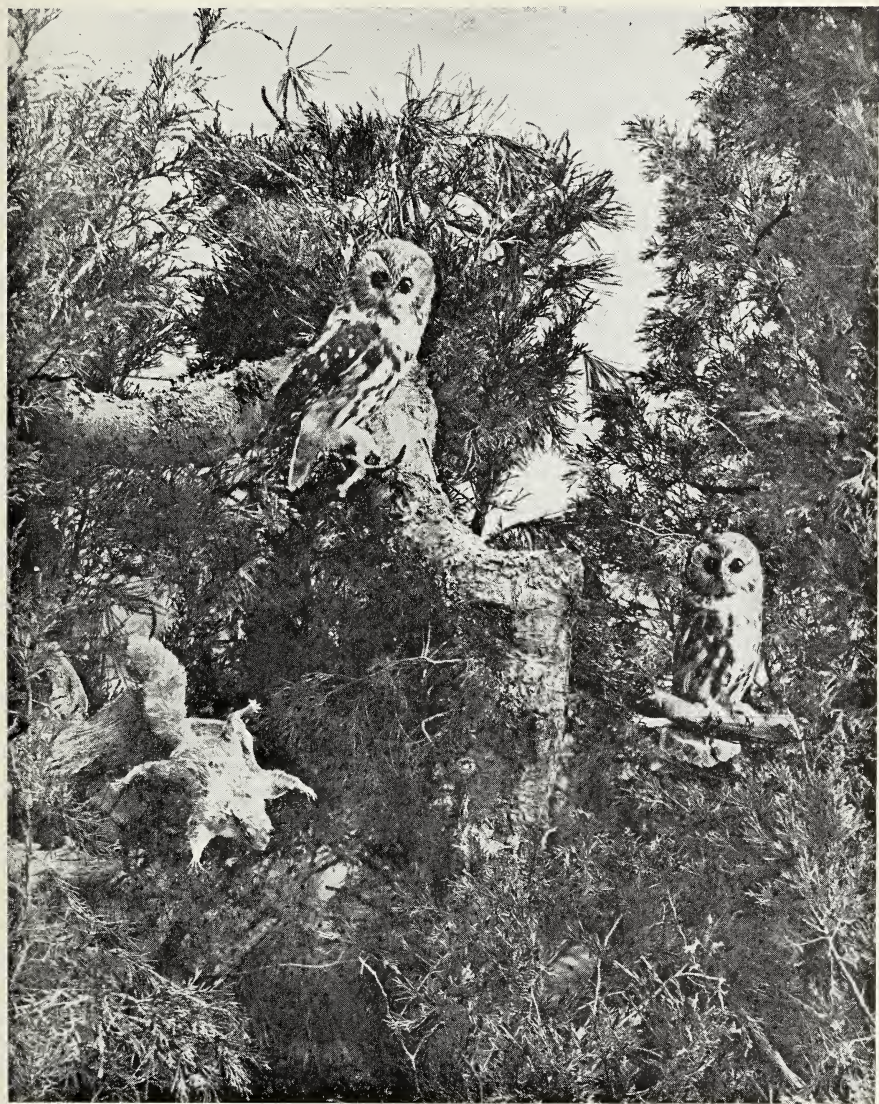


FIG. 1. Great Northern Diver, or Loon.



FIG. 2. Red Fox. Note inclusion of the same specimen of the Saw-whet Owl in the different assemblage shown on Plate IX.

ADDITIONAL EXAMPLES OF WEBSTER'S STEREOSCOPIC VIEWS



An early habitat group of Saw-whet Owls and a Flying Squirrel, assembled for the photographer in order to make a stereoscopic view. Note the use of the same owl in a different grouping shown on Plate VIII.



FIG. 1. Ruffed Grouse, an early habitat group.

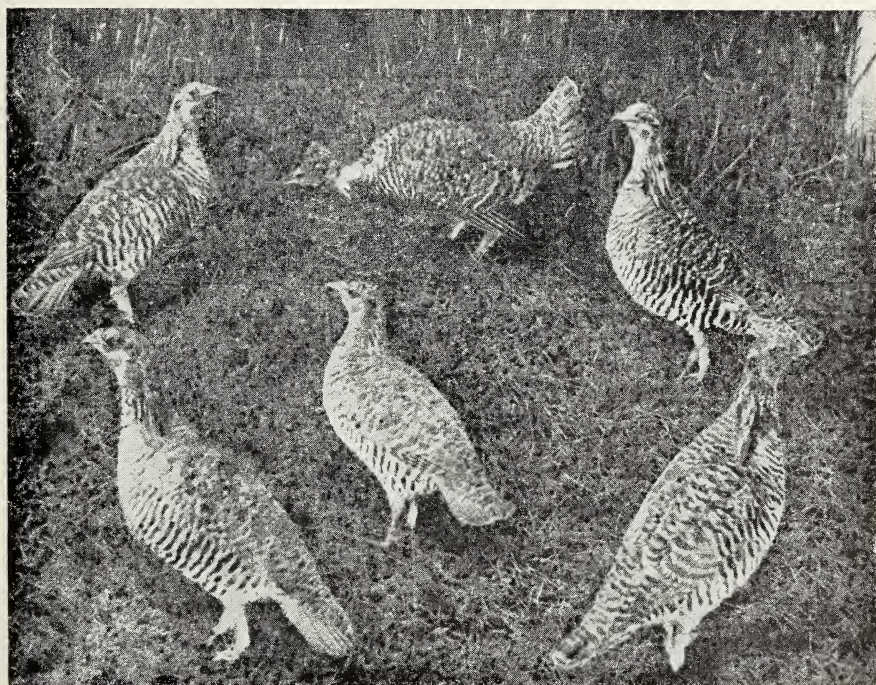
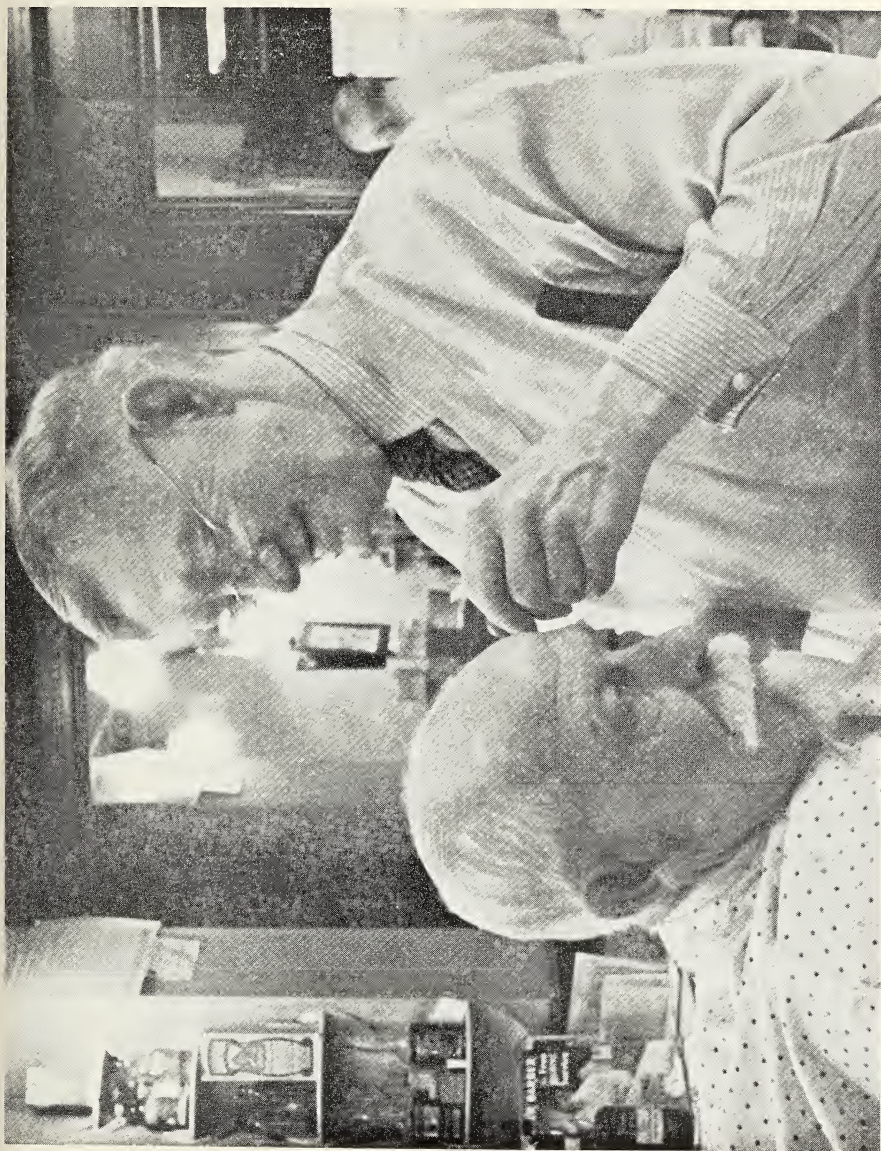


FIG. 2. The Prairie Chicken, likewise assembled to make a stereoscopic picture.



The author in the barber's chair. Camera study of Frederic S. Webster taken, without his knowledge, at Los Angeles in 1941 by his photographic friend, Ernest E. Huesser.



507, 73
4P6842

ART. XII. SCOLECODONTS FROM THE TRENTON SERIES
(ORDOVICIAN) OF ONTARIO, QUEBEC, AND NEW YORK

By E. R. ELLER

(PLATES I-VII)

INTRODUCTION

The Trenton rocks of North America have been studied for more than one hundred years, yet very little detailed and conclusive information is available in the literature. There seems to be little agreement among geologists in regard to Trenton stratigraphy. It would appear that several years of detailed field and laboratory work may be necessary to clear up the many disagreements. Since everything seems not to be right with Trenton stratigraphy, the writer will only attempt to describe the scolecodont fauna. The scolecodonts, fossil polychæte annelid jaws, are very plentiful in Trenton rocks, often outnumbering other fossil specimens. In this paper 122 species are considered, of which 115 are described as new. The Rockland formation contains by far the greater number of species. It is probable that many of the 72 species limited to the Rockland will be found in formations of the Black River group when they are studied. This may be especially true in the Ottawa valley where there seems to be almost continuous deposition. A number of species occurring in the Rockland and Cobourg were found in the Collingwood and Gloucester formations.

Collections were made from Trenton outcrops from Georgian Bay to Prince Edward County, Ontario; from northern New York; and from the vicinity of Ottawa, Ontario, to Paquette Rapids, Quebec. From each locality about 25 to 50 pounds of limestone were collected along the face of the outcrop for examination. Only rarely were scolecodonts noted on the surface of the rocks. The type of matrix does not seem to be indicative of the presence or absence of scolecodonts. It has been observed often that rocks containing few or no other kinds of fossils are apt to contain scolecodonts. The limestone from every locality dissolved readily in weak acid leaving an insoluble residue that was examined for specimens. Often a piece of limestone the size of one's fist will contain from two to three hundred specimens while from another layer or locality only a few, or none at all, may be present. In addition to the scolecodonts many other interesting fossils and minerals are often found.



MAR 25 '46

When, at a locality, several score of feet of a formation are exposed, both vertically and horizontally, it may be easily understood that the chances of missing a layer that might contain scolecodonts are considerable. Therefore, the faunal lists for the particular localities which are given subsequently may form far from the true picture. If more material was examined from each outcrop it is probable that many more species, including new ones, would be found. From these lists of fossils obtained it will be noted that the scolecodont fauna was largely collected at the Ontario and Quebec localities. This is true of the number of specimens as well as species.

The classification of the beds of the various localities is only tentative and is based partly on the scolecodont fauna, a study of the literature, and from communications and conversations with various geologists familiar with the Trenton rocks.

The localities listed below are only a few of a large number at which collections were made. The length of time needed to examine the residues from a particular locality makes it impossible to include as many as might be desired.

It has given me a great deal of pleasure to name the many species of these worms after my various friends, colleagues, and critics in the Carnegie Museum.

The holotypes of the species described in this paper and a large series of duplicate specimens are in the Carnegie Museum; the paratypes and a number of duplicate specimens have been divided between the Royal Ontario Museum of Paleontology and Princeton University.

ACKNOWLEDGMENTS

The field work for this study was made possible by grants from the American Association for the Advancement of Science and the Marsh Fund of the National Academy of Sciences.

ENUMERATION OF THE FAUNA AT SELECTED LOCALITIES

Belleville, Ontario

In the vicinity of Belleville a number of quarries expose the Hull (?) limestone. Not many scolecodonts were found but the following species were taken from the residues: *Ildraites camurus*, *Leodicites biformis*, *L.? continuus*, *Marleneites farrari*, *Paleænonites dillae*, *Staurocephalites cuneiformis*, and *S. triplus*.

Cobourg, Ontario

A considerable number of specimens were found at Cobourg, the type locality for the Cobourg limestone. However, all species found in these rocks were also common in the Rockland. The following species were identified: *Eunicites sweadneri*, *E. tolmachoffi*, *Ildraites rarus*, *Lumbriconereites deflexus*, *L. linki*, *Ænonites fissilis*, and *Paleænonites dillae*.

Collingwood, Ontario

No attempt was made to separate the upper and lower Cobourg limestone at this locality. Scolecodonts are very common and the jaws may be seen on the surface of the rocks at any outcrop. Collections were made along the Pretty River in the east end of Collingwood at Georgian Bay, in a large quarry in the east end of Collingwood, and in an abandoned quarry in the west end of the town. The limestone is thin-bedded, except in the large quarry, rubblely, argillaceous and weather gray. Of the following thirty-six species only six are limited to this formation: *Arabellites ? doutti*, *A. rectidens* Eller, *Eunicites sweadneri*, *E. tolmachoffi*, *Ildraites camurus*, *Leodicites angulus*, *L. arquatus*, *L. bisulcus*, *L. breviculus*, *L. buris*, *L. exilis*, *Lumbriconereites bicornis*, *L. concertatorius*, *L. copiosus*, *L. crassus*, *L. deflexus*, *L. johnsoni*, *L. kosinskii*, *L. langae*, *L. linki*, *L. longæ*, *Marleneites arduus*, *Marphysites aptus*, *Nereidavus alatus*, *N. avinoffi*, *N. procurvus ?*, *Ænonites adversus*, *Æ. coggeshalli*, *Paleænonites comptus*, *P. frickei*, *P. dillae*, *Staurocephalites absis*, *S. admirabilis*, *S. ? arcus*, *S. heppenstallae*, and *S. nettingi*.

Dalrymple, Ontario

A little more than a mile south of Dalrymple the highway drops over a low escarpment. Limestone crops out for about a half-mile along this road. There has been some discussion about this limestone but it is probably Trenton. Johnson (1911) describes beds thirty-five feet thick, south of Dalrymple as Leray, now known as Coboconk from Central Ontario. Kay (1942) refers it to the Rockland. At Coboconk, about fifteen miles east of Dalrymple, a sub-lithographic limestone, Gull River of Okulitch (1939), is succeeded by twelve feet of Moore Hill and twenty-one feet of Coboconk limestone to the top of the exposure in the quarry. Kay (1937) places the Moore Hill as Chaumont, Black River, and the Coboconk as Napanee-Rockland. Okulitch (1939) however states that the Coboconk should remain in the Black River. Kay based his conclusions on the fauna

which he found quite like the type Napanee. A number of specimens were found at this locality and the following species were identified: *Arabellites* ? *doutti*, *Leodicites arquatus*, *Lumbriconereites assimilis*, *Ænonites* ? *intrinsecus* and *Staurocephalites nettingi*. Two of these species are limited to the Rockland and the others extend from Rockland through Cobourg.

Downeyville, Ontario

East of Lindsay and about two miles north of Downeyville the highway cuts an outcrop of the Rockland formation. A number of scolecodont specimens were found at this locality including the following species: *Ildraites camurus*, *Lumbriconereites linki*, *L. tuberosus*, and *Staurocephalites nettingi*.

Gamebridge, Ontario

A large number of scolecodonts were found in the material from a small quarry on lot 13, concession A, Mara township. The quarry is now filled with water but it is said to be about thirty-two feet deep. The limestone is probably Rockland in age and the following scolecodont species were found: *Eunicites acus*, *E. toddi*, *Leodicites anticus*, *L. artus*, *L. creditensis* ? *Lumbriconereites curvus*, *L. deflexus*, *L. projectus*, *L. triquetrus*, *Nereidavus alatus*, *N. avinoffi*, *N. procurvus* ?, and *Staurocephalites nettingi*.

Kirkfield, Ontario

The quarry at Liftlock, near Kirkfield, contains a large fauna of scolecodonts. Of the thirty-six species identified, fourteen are limited to the Rockland, two to Rockland-Sherman Fall, and the remainder extend from Rockland through Cobourg. Kay (1937) lists a contact of the Hull and Sherman Fall in this quarry. Later Kay (1943), at the suggestion of G. Winston Sinclair, changed the Hull to Kirkfield, since Kirkfield, Johnson (1911), has precedence over Hull, Raymond (1914). Sinclair (1942) considers the Kirkfield beds to be contemporaneous with the Rockland formation. No difference in the scolecodont fauna was noted between the upper and lower beds in the quarry. The scolecodonts are as follows: *Arabellites* ? *doutti*, *A. rectidens* Eller, *Eunicites barbaricus*, *E. cavus*, *E. coniectus*, *E. kirkfieldensis*, *E. sweadneri*, *Ildraites camurus*, *I. fuehreri*, *Leodicites antefixus*, *L. artus*, *L. creditensis* Eller ?, *Lumbriconereites angustifossus*, *L. assimilis*, *L. copiosus*, *L. deflexus*, *L. jenningsi*, *L. johnsoni*, *L. linki*, *L. longae*, *L. projectus*, *Nereidavus alatus*, *N. avinoffi*, *N. procurvus* ? Eller, *Ænonites bidwelli*, *Æ. dubius*, *Æ. fissilis*, *Paleænonites*

accuratus ? Eller, *P. acutus*, *P. castigatus*, *P. clinatus*, *P. pennatus*, *Staurocephalites admirabilis*, *S. agriodos*, *S. appositus*, and *S. nettingi*.

Lakefield, Ontario

The abandoned quarry of the Canada Cement Company at Lakefield contained a large number of scolecodonts. Kay (1937) lists Hull and Sherman Falls for this locality. The scolecodont species appear, however, to be mostly Rockland and the following were identified: *Arabellites* ? *claytonae*, *A.* ? *doutti*, *Eunicites cavus*, *E. compressus*, *E. tolmachoffi*, *Leodicites agostini*, *L. angulus*, *L. artus*, *L. breviculus*, *L. brooksi*, *L. clementi*, *L. creditensis*, *L. semiquadratus*, *Lumbriconereites bicornis*, *L. concertatorius*, *L. crassus*, *L. johnsoni*, *L. linki*, *L. projectus*, *Marphysaites aptus*, *Nereidavus alatus*, *N. angulosus*, *N. procurvus*, *Paleænonites accuratus* ? *P. acutus*, *P. dillae*, *P. henryi*, *Staurocephalites absimilis*, *S.* ? *arcus*, *S. heppenstallae*, *S. miorowae*, *S. nettingi*, *Ungulites bifurcus*, and *U. sumnerae*.

Lindsay, Ontario

Three miles north of Lindsay, highway number 35 is cut through the escarpment and exposes about twelve feet of thick to thin-bedded limestone. Scolecodonts were noted on the surface of the rocks and the following species which are mostly Rockland were collected: *Eunicites cavus*, *E. toddi*, *E. twomeyi*, *E. whiteae*, *Ildraites camurus*, *I. fuehreri*, *I. rarus*, *Leodicites arquatus*, *L. biformis*, *L. breviculus*, *L. brooksi*, *L. clementi*, *L. conwallis*, *Lumbriconereites assimilis*, *L. johnsoni*, *L. linki*, *L. projectus*, *L. tuberosus*, *Marleneites arduus*, *Nereidavus angulosus*, *N. avinoffi*, *N. procurvus*, *Ænonites coggeshalli*, *Æ. fissilis*, *Paleænonites accuratus* ? *P. acutus*, *P. castigatus*, *P. circumscriptus*, *P. davisae*, *P. dillae*, *P. henryi*, *P. pennatus*, *Staurocephalites mcallae*, and *Ungulites longidentatus*.

Millington, Ontario

A small, shallow, limestone quarry, which was opened for road mettle, is located southeast of Orillia along the highway. It is now, however, filled with water from a large spring and only the top foot of limestone is exposed. A number of scolecodonts were noted on the surface of the rocks scattered near the stone crusher. The limestone is considered to be Rockland. The following species were identified from this locality: *Ænonites coggeshalli*, *Æ. bittingsae*, *Staurocephalites aduncus*, *S. heppenstallae*, and *S. nettingi*.

Napanee, Ontario

On Selby Creek, about one and one-half miles north of Napanee, Trenton rocks of Rockland age are exposed. Kay (1937) divided the Rockland into two members, the Selby and the Napanee, and used this locality as the type section. Samples of the limestone were taken from each of these two divisions but scolecodonts were found only in the Napanee. This does not mean that the exposed four feet of Selby contain no scolecodonts. Another sampling of the member might contain a number of specimens. The upper beds at this locality contained the following species: *Leodicites clementi*, *Lumbriconereites irregularis*, and *Ænonites bidwelli*.

Peterborough, Ontario

About four miles north of Peterborough a small quarry has been opened near the highway for road material. A few scolecodonts were observed on the surface of the limestone. The residues, after dissolving the limestone in acid, contained a medium number of specimens and the following species were identified: *Eunicites plackae*, *Lumbriconereites assimilis*, *L. linki*, *Marleneites millerae*, *Nereidavus alatus*, *Paleænonites circumscriptus*, and *Staurocephalites kayi*. A Rockland age for the limestone is indicated by the above scolecodonts.

Port Hope, Ontario

The Cobourg limestone outcrops along the small stream that runs through the center of Port Hope. It is a thin-bedded limestone with considerable shale partings. At the north end of the town, near the dam site of the old "hydro" company, the limestone again crops out. This is more than a mile upstream from the outcrops in the center or eastern end of the town. Although there is a slight southerly dip of the strata it is possible that the total thickness of the Cobourg at Port Hope is greater than has been reported. The following species were found: *Arabellites rectidens* ? Eller, *Ænonites impardentatus*, and *Paleænonites dillae*.

Hull, Quebec

A large number of specimens were found in the limestone residues of the Hull formation from the quarries at Hull. Only three species were identified and they are common to the Rockland and Cobourg: *Diopatraites* sp., *Lumbriconereites linki*, *Staurocephalites heppenstallae*, and *S. nettingi*. From the Philemon Island, Ottawa River at Hull, *Diopatraites* sp., and *Ildraites rarus* were recorded.

Paquette Rapids, Ottawa River, Quebec

The collections in the Carnegie Museum from Paquette Rapids, just north east of Allumette Island, are labeled "Black River." In the literature the age of the limestone at this locality has been given as Leray, Black River, and Trenton. Kay (1937) found the fauna to be equivalent to the Cloche Island limestone of the Rockland formation. Scolecodonts were found to be common at Paquette Rapids and twenty-five species were identified, eighteen of which are attributed only to the Rockland. The following scolecodonts were found: *Diopatraites fustis*, *Eunicites barbaricus*, *E. tolmachoffi*, *E. planoconvexus*, *E. toddi*, *E. whiteae*, *Leodicites corbis*, *L. collatatus*, *L. convallis*, *Lumbriconereites linki*, *L. projectus*, *L. langae*, *Marleneites arduus*, *M. aureus*, *Ænonites coggeshalli*, *Æ. bidwelli*, *Orthopelta ? femoralis*, *O. ? bifidus*, *Paleænonites clinatus*, *Staurocephalites nettingi*, *S. mccallae*, *S. kayi*, *S. paquettensis*, *S. arcus*, and *Ungulites bifurcus ?*.

Three Rivers, Quebec

A small specimen of limestone from the St. Maurice quarry north of Three Rivers was dissolved in acid. This piece of limestone measured only three by two inches in size but more than 400 scolecodonts were recovered from the residue. It was made available through the kindness of Professor V. J. Okulitch. From among the specimens 52 species were identified and the following distribution was noted: 10 species were found only at this locality, 21 species were limited to the Rockland, 3 species extended into the Sherman Fall, and 18 species extended into the Cobourg. From the above data it is suggested that the Three Rivers locality is Rockland in age. Professor Okulitch, however, found at least one specimen of *Rafinesquina deltoidea* from this locality which usually suggests fairly high Trenton. The following scolecodonts were recorded: *Arabellites ? doulti*, *Diopatraites tricusps*, *Eunicites aculeus*, *E. acus*, *E. ansatus*, *E. cavus*, *E. colossus*, *E. compressus*, *E. geisacanthus*, *E. sweadneri*, *E. tolmachoffi*, *E. whiteae*, *Ildraites rarus*, *Leodicites angustisulcus*, *L. artus*, *L. biformis*, *L. breviculus*, *L. brooksi*, *L. clementi*, *L. convallis*, *L. semiquadratus*, *Lumbriconereites angustifossus*, *L. assimilis*, *L. dissimilis*, *L. kosinskii*, *L. linki*, *L. longae*, *L. okulitchi*, *L. projectus*, *L. tuberosus*, *Marleneites arduus*, *M. farrari*, *Nereidavus alatus*, *Ænonites coggeshalli*, *Æ. ? dubius*, *Paleænonites acutus*, *P. castigatus*, *P. circumscriptus*, *P. clinatus*, *P. davisae*, *P. dillae*, *Siluropelta calcaratus*, *Staurocephalites ? absimilis*, *S.*

appositus, *S. ? arcus*, *S. bijugus*, *S. kayi*, *S. mcallae*, *S. nettingi*, *Ungulites bifurcus*, *U. confertus*, and *U. sumnerae*.

Copenhagen, New York

The Hallowell member, Kay (1937), of the Cobourg is present in a quarry at Copenhagen. A few specimens were noted on the surface of the rocks and the following species were found in the residues after the limestone was dissolved in acid: *Eunicites tolmachoffi*, *Leodicites clementi*, and *Staurocephalites nettingi*.

Below High Falls and the power plant at Copenhagen, the Denmark member, Kay (1937), of the Sherman Fall was examined. Although no scolecodonts were found on the surface of the limestone the residues produced the following species: *Ildraites fuehreri*, which has wide distribution in the Rockland and Cobourg formations, *Lumbriconereites macmillani* and *Nereidavus artatus* found only at this locality, and *Paleænonites acutus* and *P. clinatus* which are limited to the Rockland.

Henderson, New York

The state highway (No. 3), in a road cut at a locality about one mile from Henderson and Henderson Harbor exposes the Sherman Fall. Only a few specimens were found and the following species were identified: *Arabellites rectidens* ? Eller, *Leodicites clementi*, and *Paleænonites dillae*.

Lowville, New York

Kay (1937) separates the Rockland at Lowville into the Selby and Napanee members. Scolecodonts were common in both members and no species was limited to either one. *Leodicites absolutus* and *Marleneites aureus* were found only at this locality. The following species found at Lowville have wide distribution: *Eunicites tolmachoffi*, *Ildraites camurus*, *Lumbriconereites assimilis*, *L. linki*, *Marleneites farrari*, *Staurocephalites cuneiformis*, *S. heppenstallae*, and *S. nettingi*.

Watertown, New York

About three miles south of Watertown, on the road to Rodman, the highway cuts the escarpment and exposes Trenton rocks. Seven species of scolecodonts were found at this locality. All forms, except a questionable one, have been found in both the Rockland and Cobourg formations: *Leodicites breviculus*, *Lumbriconereites deflexus*, *L. bicornis*, *L. projectus*, *L. linki*, *Nereidavus alatus*, and *Paleænonites accuratus* ? Eller.

DESCRIPTIONS OF SPECIES

Genus LUMBRICONEREITES, Ehlers, 1868

Lumbriconereites linki sp. nov.

Maxilla I, plate I, figs. 1-3.

The jaw is elongate and not very wide. Measurements of the jaw range between 0.35 mm. and 1.02 mm. in length. Along the nearly straight inner margin a series of fourteen to sixteen blunt, conical denticles extends nearly to the posterior end. The fang is small and pointed and appears to be a continuation of the outer margin. Together with the fang, the first three denticles may point forward. The largest denticles are found at the mid-area and posteriorly they decrease gradually in size. A small indentation at about the mid-point on the outer margin forms a small, angular shank. The inner margin is gently rounded. A large fossa is present on the upper side. The margins of the fossa are slightly thickened and rounded. The under side is flattened and slightly concave adjacent to the denticles.

The straightness of the margin bearing the denticles and the shape of the shank differentiate this form from other related species.

Occurrence: The form is found throughout the Trenton and is widely distributed from Collingwood, Ontario, to Lowville, New York.

Type: Holotype in Carnegie Museum, number 25,285; a paratype in Princeton University Museum.

Lumbriconereites concertatorius sp. nov.

Maxilla I, plate I, figs. 4-6.

The jaw is narrow and elongate. A series of fourteen sharp-pointed, conical, backward directed denticles extends the full length of the jaw. The denticles at the anterior part of the jaw are nearly in the same plane with the upper surface of the jaw, while the denticles at the posterior are oblique to the surface. The fang is large and pointed, but not hooked. The denticles are nearly uniform in size and become only slightly smaller at the posterior end. On the outer margin two small indentations form a small shank. A shallow fossa occupies about one-half of the jaw. The margins of the fossa are thickened and rounded except along the outer edge. The upper side of the jaw is curved while the under side is flattened. The type specimen measures 0.75 mm. in length.

This species seems to be half way between forms described under the genera *Enonites* and *Lumbriconereites*. A synopsis of its specific relationships will not be attempted at this time. When the form is viewed from the under side the bight and protuberance on the outer margin suggest that the species belongs under the genus *Lumbriconereites*. If the form is examined from the upper side the protuberance appears to be part of the fossa. The side view resembles many species of *Lumbriconereites*. However, when considered as a whole it has very few of the characteristics of a typical species of *Lumbriconereites*. Some of the figured specimens of *L. copiosus* Eller (1942) show a likeness in a general way to *L. concertatorius*.

Occurrence: The form is found in the Upper Cobourg at Collingwood, Ontario, and in the Rockland at Lakefield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,308.

***Lumbriconereites curvus* sp. nov.**

Maxilla I, plate I, figs. 7, 8.

The jaw is small and measures 0.59 mm. in length. Along the curved inner margin a series of seventeen sharp-pointed, conical, backward directed denticles extends the full length of the jaw. The first denticle or fang is large, well hooked, and is not in alignment with the other denticles. The denticles are quite uniform in size and become smaller only at the posterior end. The outer margins are irregularly curved and form narrow but long flanges on both the sides. A long narrow fossa occupies about three-quarters of the length of the upper side of the jaw. The margins of the fossa are wide and flattened. The posterior end is acute. Both upper and under sides of the jaw are flattened.

Lumbriconereites proclivis Eller (1942) has a general resemblance to *L. curvus*. Two species described in this paper, *L. jenningsi* and *L. tuberosus* are similar to *L. curvus* in some details. Stauffer (1933) described several species under the genus *Protarabellites* that resemble *L. curvus*. Only the under surface of Stauffer's specimens are shown; thus a detailed comparison cannot be made. A relationship may be noted between *L. cooperi* Eller (1938), figures 1-4, and *L. curvus*.

Occurrence: The figured specimen is from the Rockland at Gamebridge, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,362.

***Lumbriconereites projectus* sp. nov.**

Maxilla I, plate I, figs. 9-11.

The jaw is narrow and elongate. Measurements of the jaw range between 0.59 mm. and 1.08 mm. in length. A series of thirteen to eighteen sharp, conical, backward directed denticles extends nearly to the posterior end. Most of the denticles are in an oblique position to the under surface of the jaw. The fang is not large and is followed by a small denticle. The remaining denticles are uniform in size nearly to the posterior end, where they become rapidly smaller. A large flange is present in the anterior end of the jaw. On the opposite, irregularly curved, margin a very small flange-like projection is found opposite the third denticle. A large fossa occupies most of the upper surface of the jaw. The margins of the fossa are thin and rounded, except near the small flange-like projection where it is thickened. The posterior end of the jaw is very narrow, due to a deep, crescent-shaped bight. The under surface of the jaw is flattened between the denticles and the flange.

L. cooperi Eller (1938), figures 7, 8, resembles *L. projectus* in a general way. The position of the shank is the same but the arrangement of the denticles is different. *L. cooperi*, figures 5, 6, differs from *L. projectus* and when more is known of the Devonian fauna, *L. cooperi*, figures 7, 8, should probably be considered as a different form. Stauffer (1933) described a form, *L. cameratus*, from the basal Platteville of Minnesota that is similar in its general shape to *L. projectus* but lacks the small shank-like projection on the margin.

Occurrence: *L. projectus* is common in the Rockland and was found from Lindsay, Ontario, to Watertown, New York.

Type: The holotype is in the Carnegie Museum, number 25,273; paratypes have been deposited in Princeton University Museum and the Royal Ontario Museum of Paleontology.

***Lumbriconereites crassus* sp. nov.**

Maxilla I, plate I, figs. 12, 13.

The jaw is thick, elongate and wide anteriorly. Specimens measure from 0.64 mm. to 1.08 mm. in length. Along the arched inner margin a series of large, triangular denticles extends about three-fourths the length of the jaw. The fang or first denticle is large, pointed, hooked and not in alignment with the other denticles. The second denticle is medium-sized

and the third is small. The denticles then become large but decrease in size posteriorly. A small, thick, angular shank is present on the outer margin in the posterior half of the jaw. The small bight adjacent to the shank forms with the rounded inner margin an acute posterior extremity. On the upper side of the jaw a small, shallow fossa is present. It occupies the posterior end of the jaw. The margins of the fossa are not thickened except adjacent to the denticles. Both the upper and under surfaces of the jaw are convex.

L. deflexus Eller (1942) resembles *L. crassus* in a general way but differs in the thickness of the jaw, the shape and character of the fossa and the number and position of the denticles.

Occurrence: The species is found in the Rockland at Lakefield, Ontario, and in the Cobourg at Collingwood, Ontario.

Types: Holotype in Carnegie Museum, number 25,304; a paratype in the Royal Ontario Museum of Paleontology.

***Lumbriconereites langae* sp. nov.**

Maxilla I, plate I, figs. 14,15.

The jaw is wide at the mid-area and tapers gradually to acute anterior and posterior extremities. The described specimen measures 1.13 mm. in length. A series of fourteen or fifteen small, conical, backward directed denticles extends the full length of the jaw. When a specimen is viewed from the under side, the three or four anterior denticles are directed to the left, the next few are about perpendicular to the surface, and the remaining posterior denticles point to the left. The fang is heavy, not hooked, and tapers rapidly to a point. The second denticle is quite large and may not point in a backward direction. The remaining denticles decrease gradually in size to the posterior end. In the posterior half of the jaw a small bight emphasizes the width of the jaw. The shank is small and its anterior margin is nearly straight to the fang. A shallow fossa occupies about half of the upper surface of the jaw. The margins of the fossa are rounded and thickened, especially the inner margin of the jaw. Except for the area adjacent to the denticles on the under side, both surfaces are, in general, convex.

There is a resemblance between *L. dubius* Stauffer (1933) and *L. langae*, especially in the character of the denticles. Other details differ slightly. Since only the under surface of Stauffer's species is shown a complete analysis cannot be made.

Occurrence: In an abandoned quarry, in the west end of Collingwood, Ontario, thin-bedded, rubbly Upper Cobourg limestone contained an abundance of these jaws.

Type: The holotype is in the Carnegie Museum, number 25,188.

***Lumbriconereites jenningsi* sp. nov.**

Maxilla I, plate I, figs. 16-18.

The jaw is elongate with irregular lateral margins. The figured specimen measures 0.45 mm. in length. A series of sixteen small, blunt denticles extends the full length of the jaw. The anterior denticles point in a forward direction while the posterior ones point backwards. The fang is long, sharp and somewhat hooked. When the jaw is viewed from the under side, it may be seen that the fang and the two following denticles are out of alignment with the other denticles. Most of the denticles are of uniform size. The outer margin is nearly straight to a small, rounded shank and continues from a very shallow bight to the blunt posterior end. A small rounded flange is also present on the inner margin. About two-thirds of the upper side is occupied by a shallow fossa. The inner and anterior margins of the fossa are thickened and rounded.

It is probable that this form is the left jaw of an asymmetrical right and left Maxilla I. Some species of *Ænonites* resemble this form. *L. proclivis* Eller (1942) is similar to *L. jenningsi*. The flanges on the lateral margins are alike but their positions differ. The arrangement of the denticles is similar but the shape, especially of the fang, is not the same. The fossa and the posterior extremity of the forms are quite different. There is slight resemblance between *L. cooperi* Eller (1938) and *L. jenningsi*.

Occurrence: The quarry at Liftlock near Kirkfield, Ontario, is considered to be Rockland for the present. A large number of jaws were found at this locality including the above described form.

Type: The holotype is in the Carnegie Museum, number 25,259.

***Lumbriconereites irregularis* sp. nov.**

Maxilla I, plate I, figs. 19-21.

The jaw is small, irregular in shape, and the described specimen is 0.38 mm. in length. Along the center of the under side a series of eight or nine small, sharp-pointed, backward directed denticles extends about three-quarters the length of the jaw. The fang is large and blunt. A second large denticle is present on the inner margin and is not in line

with the other denticles. There is a space between the fang and the regular series of denticles. On the outer margin a heavy shank is present and is only slightly emphasized by the shallow bight. The posterior of the jaw ends in an acute extremity. A shallow fossa occupies the posterior half of the jaw. The margins of the fossa are thickened and rounded. The upper and under sides of the jaw are convex except for some flattened areas.

Lumbriconereites irregularis resembles other species of the genus only in a general way.

Occurrence: About one and one-half miles north of Napanee, Ontario, on Selby Creek. Kay (1937) has divided the Rockland into the Selby and Napanee members; *L. irregularis* was found in the upper beds.

Type: The holotype is in the Carnegie Museum, number 25,200.

***Lumbriconereites macmillani* sp. nov.**

Maxilla I, plate I, figs. 22-24.

The jaw is small, suboval in outline and the figured specimen measures 0.27 mm. in length. A series of thirteen small, conical sharp pointed denticles extends nearly the full length of the jaw. The denticles point in a perpendicular direction to the inner margin and decrease slightly in size to the posterior end. The first denticle or fang is small, hooked, and not in alignment with the other denticles. A large, deep fossa occupies about two-thirds of the upper area of the jaw. The margins of the fossa are slightly thickened anteriorly and heavy and well rounded posteriorly. The upper and under surfaces of the jaw are highly convex.

Lumbriconereites macmillani is similar in a general way to several right jaws of the genus. It differs from them in its width, regularity of outline, and smoothness of surface features. If the form were not viewed from all sides it might be considered to belong to the genus *Ænonites*.

Occurrence: The figured specimen was collected at Copenhagen, New York, below High Falls and the power plant.

Type: The holotype is in the Carnegie Museum, number 25,211.

***Lumbriconereites johnsoni* sp. nov.**

Maxilla I, plate I, figs. 25, 26.

The jaw is wide, long, and measures from 0.83 mm. to 2.29 mm. in length. An average specimen measures about 1.5 mm. A series of thirteen to eighteen large, conical, backward directed denticles extends the com-

plete length of the jaw. The posterior denticles are oblique to the under surface. A fang, just slightly larger than the second denticle, is not in alignment with the series. The denticles are nearly uniform in size and become smaller only at the posterior end. A very wide and angular shank is present at the mid-area of the jaw. The crescent-shaped bight posterior to the shank is not deep. The opposite margin is gently rounded. The anterior region of the jaw is wide, while the posterior is narrowly truncate. A large, shallow fossa occupies about two-thirds the upper side of the jaw. The margins of the fossa are rounded but not thickened. The surfaces of the jaw are irregularly concave and convex.

Except for a general likeness, there is not sufficient similarity between other species and *Lumbriconereites johnsoni* to warrant comparisons.

Occurrence: The figured specimen is from the Rockland near Lindsay, Ontario, where it was very common. It was also found in the Cobourg.

Type: The holotype is in the Carnegie Museum, number 25,237. Paratypes are in the Royal Ontario Museum of Paleontology and Princeton University.

***Lumbriconereites triquetrus* sp. nov.**

Maxilla I, plate I, figs. 27, 28.

The jaw is long, very narrow, and measures 1.22 mm. in length. On the straight inner margin, a series of twenty-one sharp-pointed, backward directed, triangular denticles extends nearly the full length of the jaw. The first denticle or fang is large, conical, and straight. The second denticle is small, triangular, and points directly backwards. Following the five minute denticles are two small, broadly triangular, teeth that are perpendicular to the inner margin. The remaining denticles are larger and decrease in size gradually to the posterior end. A narrow fossa occupies about three-quarters the length of the jaw. The right margin of the fossa when viewed from the upper side is slightly thickened and rounded. The opposite margin is thin and probably broken. It is possible that a small flange was present at about the mid-area. The sides of the jaw are nearly parallel and the posterior end is blunt. If the jaw was observed in cross section it would have nearly the appearance of an isosceles triangle of which the sides would be concave.

Only one specimen of this form was found and probably it is broken. The character and arrangement of the denticles of *L. triquetrus* is similar to *L. copiosus* Eller (1942). Two species, *L. assimilis* and *L. bicornis* described in this paper have a general relationship to *L. triquetrus*. Except

for the denticles, certain specimens of *L. scrobiculus* Eller (1944), figs. 3, 4, are similar to *L. triquetrus*.

Occurrence: The figured specimen is from the Rockland at Gamebridge, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,361.

***Lumbriconereites bicornis* sp. nov.**

Maxilla I, plate I, figs. 29, 30.

The jaw is large, elongate, and measures from 0.89 to 1.29 mm. in length. A series of twenty-one short, angular denticles extends the full length of the slightly arched inner margin. The first and second denticles are very large and hooked. The remaining denticles are small but increase in size to the mid-area and then become smaller to the posterior end. All the denticles are slightly oblique to the under side. A narrow curved fossa occupies about two-thirds of the upper side of the jaw. The left margin of the fossa when observed from the upper side is only slightly thickened while the right margin is wide and rounded. The jaw is widest at the mid-point and the posterior end is obliquely truncate. Both upper and under sides of the jaw are irregularly convex and concave. The area adjacent to the denticles is especially flattened or concave.

The wide posterior end is not common for species of *Lumbriconereites*. There is a general likeness between *L. cooperi* Eller (1938) and *L. bicornis*. The posterior end and the shape and size of the fossa are not the same. *L. scrobiculus* Eller (1945) has a truncate posterior end similar to *L. bicornis* but the fossa and denticles are different. There is a very slight relationship between *L. tuberosus* and *L. bicornis*.

Occurrence: The form was found at Watertown, New York, Lakefield, Ontario, and in the Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,359.

***Lumbriconereites longae* sp. nov.**

Maxilla I, plate I, figs. 31-33.

The jaw is elongate and narrow, anteriorly and posteriorly. Specimens measure from 0.75 mm. to 1.80 mm. in length. A series of eleven to fourteen sharp, conical, backward directed denticles extends nearly the full length of the jaw. The fang is large but not well hooked. The second or third denticle is often minute. The remainder of the denticles increase in size to the mid-area and then decrease gradually to the posterior end.

The outer margin curves outward from the posterior and anterior ends to form an angular shank in the posterior half of the jaw. A shallow fossa is present in the posterior area. The margins of the fossa are slightly thickened and rounded. The under side of the jaw is irregularly flattened and the area between the denticles and shank is concave. The upper side of the jaw is mostly convex, especially in the fossa.

Due to the long and narrow anterior region this form is unlike other species of the genus.

Occurrence: The species was found in the Cobourg and Rockland. Most of the specimens came from Collingwood, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,341. Paratypes are in Princeton University and the Royal Ontario Museum of Paleontology.

***Lumbriconereites tuberosus* sp. nov.**

Maxilla I, plate I, figs. 34-36.

The jaw is large, narrow and elongate. Specimens measure between 0.83 mm. and 1.4 mm. in length. A series of eighteen to twenty conical, sharp-pointed denticles extends nearly the full length of the jaw. The fang is long, sharp and slightly hooked. It is out of alignment with the rest of the denticles. The second denticle is large and may be in an oblique position to the under side of the jaw. The next two or three denticles are thin or small and perpendicular to the surface of the jaw. Following these are a number of large denticles. The remainder decrease gradually in size to the posterior end. Except for anterior denticles, all point in a backward direction. Beginning at about the mid-point, the inner margin is extended to a narrow flange that extends to the posterior end. In the anterior portion of the outer margin a broadly rounded flange is present that also may be irregular in shape. The posterior is truncate and the extremity may end in a knob-like projection. A wide, shallow fossa occupies about two-thirds the upper side of the jaw. The margins of the fossa are not thickened. The under side of the jaw is convex except for the areas adjacent to the denticles.

This is probably a right jaw. It is not possible to determine the asymmetrical left jaw. *L. cooperi* Eller (1938), figs. 1-4, is similar to *L. tuberosus* except for the outer and inner margins and the posterior end. There is a general resemblance between *L. scrobiculus* Eller (1943) and *L. tuberosus*. They differ in outline and the arrangement of the denticles.

Occurrence: The species was found in the Rockland and Cobourg and the

figured specimen is from the escarpment about three miles north of Lindsay, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,191.

***Lumbriconereites kosinskii* sp. nov.**

Maxilla I, plate II, figs. 1, 2.

The jaw is small, irregular in outline and the figured specimen measures 0.32 mm. in length. A series of more than twenty minute, sharp pointed, backward directed denticles extends the full length of the jaw. The first denticle or fang is large and hooked. When the jaw is observed from the upper side, two small flanges are discernible in the anterior part of the jaw. The left one is rounded with a small indentation or bight posterior to it. The right flange is small and pointed. A large, irregular fossa extends nearly the full length of the upper side. The margins of the fossa are thickened and rounded.

L. kosinskii is very similar to *L. projectus*. They differ in number of denticles and the shape and size of the flanges. A large number of specimens of *L. projectus* were present in the fauna and they showed very little variation. For these reasons the above described form is being placed in a separate category. There is a resemblance between *L. cooperi* Eller (1938), figs. 7, 8, and *L. kosinskii*.

Occurrence: Just west of Collingwood, Ontario, the Cobourg limestone outcrops along Georgian Bay.

Type: The holotype is in the Carnegie Museum, number 25,320.

***Lumbriconereites dissimilis* sp. nov.**

Maxilla I, plate II, figs. 3-6.

The jaw is elongate and all specimens are about 0.75 mm. in length. The lateral margins are gently curved and are nearly parallel to each other. Along the inner margin a series of about fourteen small, blunt, backward directed denticles extends the full length of the jaw. The denticles are nearly the same size and only decrease slightly to the posterior end. The first denticle or fang is slightly larger. It is quite straight and points in a forward direction. A large fossa occupies nearly all the upper side of the jaw. One margin of the fossa is thin and is broken on all specimens. At the anterior end of this margin a shank of some sort was probably

present. The other lateral margin of the fossa is thickened and becomes very wide at the posterior end. The anterior margin is straight and forms sharp angles with the lateral margins. The posterior end is blunt and indented. The under side of the jaw is convex except for the area at the posterior end between the denticles and the outer margin.

Lumbriconereites dissimilis is probably a left jaw. It resembles only slightly other species of the genus. None of the specimens are very well preserved and it is possible the shank is better developed than is shown in the figures. Its position in the anterior part of the jaw is unusual.

Occurrence: This species was found only at the St. Maurice Quarry, north of Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,453; also a paratype, number 25,454.

***Lumbriconereites angustifossus* sp. nov.**

Maxilla I, plate II, figs. 7, 8.

The jaw is elongate, wide at about the mid-area but narrowing rapidly to the posterior end. The figured specimen measures 1.48 mm. in length. Along the inner margin a series of sixteen conical, backward directed denticles extends nearly the full length of the jaw. The first denticle or fang is large and slightly hooked. The second denticle is large but is followed by a much smaller one. The remaining denticles are large and decrease in size only near the posterior end. When the jaw is observed from the under side it may be seen that the denticles are not perpendicular but are inclined inward. The lateral margins are irregular in shape. An angular shank is present in the posterior half of the jaw. It forms the anterior margin of a deep crescent-shaped bight. The surface of the shank is irregularly concave and convex. On the upper side a large fossa occupies a little more than one-half of the jaw. Except for a narrow, deep, central trough, the fossa is shallow with an irregular bottom surface. The unevenness of the surface of the shank and fossa are reflected on the under surface of the jaw. The posterior extremity of the jaw is narrow and truncate.

There is a slight resemblance between *L. deflexus* Eller (1942) and *L. angustifossus*, especially in the angularity of the shank. The fossa in each of the two species is quite different.

Occurrence: The figured specimen is from the Gloucester at Craigleith, Ontario, but this form is common in the Rockland.

Type: The holotype is in the Carnegie Museum, number 25,433.

***Lumbriconereites ? okulitchi* sp. nov.**

Maxilla I, plate II, figs. 9, 10.

The jaw is triangular in outline, wide anteriorly, and tapers to a narrow posterior extremity. The figured specimen measures 0.78 mm. in length. Along the outer margin a series of twelve large, conical, sharp-pointed denticles extends the full length of the jaw. The fang is large, pointed, and wide at the base. The second denticle is small and is followed by a larger tooth. Except for the fang the fourth denticle is the largest in the series. The remainder of the denticles decrease in size gradually to the posterior end. The denticles are directed only slightly backward. A deep crescent-shaped indentation or bight is present on the outer lateral side of the jaw and forms the posterior margin of a narrow shank. When the jaw is viewed from the under side the gracefulness of the outline, especially the curvature of the outer margin, can be observed. The anterior margin is straight or slightly incurved. A fossa occupies nearly the complete upper side of the jaw. It is wide anteriorly but becomes very narrow in the posterior half. The margins of the fossa are slightly thickened and rounded.

Lumbriconereites ? okulitchi differs from other species of the genus due to the straightness of the anterior margin. Other characteristics are similar to the right jaws of several species of *Lumbriconereites*.

Occurrence: The figured specimen is from St. Maurice Quarry north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,455.

***Lumbriconereites assimilis* sp. nov.**

Maxilla I, plate II, figs. 11-21.

The jaw is elongate and measures from 0.72 mm. to 1.62 mm. in length. On the outer margin a series of fifteen to nineteen small, conical, sharp-pointed denticles extends nearly to the posterior end. The first denticle or fang is of medium size and points in a forward direction. The following four or five denticles are small but the second denticle may be slightly larger. These denticles vary in the direction in which they point from forwards to backwards. The remaining denticles are larger but decrease in size to the posterior, and they are backward directed. A large fossa occupies about three-quarters of the upper side of the jaw. The margins of the fossa are slightly thickened. The jaw tapers to an acute posterior extremity.

L. assimilis resembles *L. scrobiculus* Eller (1944) and *L. cooperi* Eller (1938) rather closely. They differ, however, in several respects. The fang of *L. assimilis* is heavier, not so long, and points in a more forward direction than in the two above mentioned species. The posterior end of *L. scrobiculus* and *L. cooperi* is more rounded than that of *L. assimilis*. The shapes and lengths of the fossa do not agree in the three species. The outer margin of *L. scrobiculus* and *L. cooperi* has the suggestion of a small shank, while the outer margin of *L. assimilis* is straighter or slightly rounded. There is a slight likeness between *L. copiosus* Eller (1942) and *L. assimilis*, especially when viewed from certain sides. The presence of a definite shank on *L. copiosus* and the larger fossa of *L. assimilis* constitute differences.

Occurrence: This species was very common in the Rockland and was found from Kirkfield, Ontario, to Lowville, New York.

Types: The holotype is in the Carnegie Museum, number 25,213. Paratypes have been sent to Princeton University and the Royal Ontario Museum of Paleontology, while paratypes, numbers 25,215, 25,217, 25,219 and 25,221 remain in the Carnegie Museum.

***Lumbriconereites copiosus* ? Eller**

Maxilla I

Lumbriconereites copiosus Eller, 1942, Annals, Carnegie Museum, vol. xxix, pp. 245, 246, pl. 1, figs. 7-12.

Specimens of *Lumbriconereites copiosus* Eller from the Meaford formation, Upper Ordovician, were found in large numbers at Streetsville, Ontario, but they varied somewhat in form. Two specimens attributable to this species were found in the Cobourg at Collingwood, Ontario. One doubtful specimen was collected in the Rockland at Kirkfield, Ontario.

***Lumbriconereites deflexus* ? Eller**

Maxilla I

Lumbriconereites deflexus Eller, 1942, Annals, Carnegie Museum, vol. xxix, pp. 244, 245, pl. 1, figs. 5, 6.

These specimens are referred to *Lumbriconereites deflexus* Eller with some doubt. They were found at a number of localities in the Trenton from Collingwood, Ontario, to Watertown, New York. The original forms, found in the Meaford, Upper Ordovician at Streetsville, Ontario, are much larger in size.

Genus ARABELLITES, Hinde, 1879

Maxilla I, plate II, figs. 22-25.

Arabellites rectidens ? Eller

Arabellites rectidens Eller, 1940, Annals, Carnegie Museum, Vol. 28, p. 15, pl. 3, figs. 1-5.

This species is common in the Manitoulin beds of Silurian age in Ontario and New York. A form, *Arabellites spicatus* var. *contractus* Hinde (1880) from the Wenlock group of England, later changed to *Arabellites contractus* by Hinde (1882) in his description of the jaws from the Silurian of Gotland, is very similar to *Arabellites rectidens*. This form seems to have both a wide geological and geographical range. The specimens from the Trenton rocks range from 0.35 mm. to 0.64 mm. in length. They average less than half the size of the Manitoulin forms. The number of denticles varies from six to eight. The principal difference between the Manitoulin and Trenton specimens is the shape of the fang. In most of the Manitoulin forms the fang points in a forward direction, while the fangs of the Trenton forms are well hooked. Whether this constitutes a specific difference the writer is unable to decide at the present time.

Occurrence: *Arabellites rectidens?* Eller is found throughout the Trenton beds from Collingwood, Ontario, to Henderson, New York.

Types: The holotype is in the Carnegie Museum, number 25,327; a paratype no. 25,328. A specimen has been deposited in Princeton University.

Arabellites (?) claytonae sp. nov.

Maxilla I, plate II, figs. 26, 27.

The jaw is wide, elongate, and measures from 0.62 mm. to 0.75 mm. in length. The posterior end is truncate. A series of nine or ten sharp-pointed, conical, backward directed denticles extends the full length of the jaw. The fang is small, sharp-pointed and is directed in a forward position. The first few denticles are large and uniform in size, and then they become smaller gradually to the posterior end. The outer margin of the jaw is irregularly curved to a small flange. A deep fossa begins opposite the second or third denticle and extends to the posterior end. The inner and anterior margins of the fossa are thickened and rounded.

Both the upper and under sides of the jaw are irregularly concave and convex.

Arabellites perpensus Eller (1942) is similar to *Arabellites claytonae*, except for the size of the fossa and the shape of the outer margin. The fossa of *Arabellites perpensus* and *Arabellites claytonae* do not resemble those of most species of *Arabellites*, but are more like those found in *Ænonites*. The truncate posterior end is not characteristic of *Ænonites* but is found generally in *Arabellites claytonae*.

Occurrence: Most specimens were found in the Rockland at Lakefield, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,303. A paratype is in the collections of the Royal Ontario Museum of Paleontology.

***Arabellites ? doutti* sp. nov.**

Maxilla I, plate II, figs. 28-29.

The jaw is large and wide, and terminates with a truncate posterior extremity. Specimens range from 1.16 mm. to 1.35 mm. in length. A series of nine to eleven sharp-pointed, conical, backward directed denticles extends for about two-thirds the length of the jaw. A long, narrow, well-hooked fang is oblique to the surfaces of the jaw. The denticles decrease gradually in size to the posterior end and are turned in an oblique position to the under surface. A large, shallow fossa extends the full length of the jaw. The inner margin of the fossa is thin but well rounded, while the anterior margin is wide, thick and flattened. This heavy part of the margin continues part way along the outer side of the jaw. The remainder of the outer margin is thin and usually broken. The under side of the jaw is convex with some flattened areas.

This species was placed in the genus *Arabellites* with doubt. The fossa of this species is not characteristic of the genus *Arabellites* but resembles more a species of *Ænonites*. The truncate posterior denticles and hook are characteristic of *Arabellites*. *A. perpensus* Eller (1942) is quite similar to *A. doutti*. They differ in the length of the fang, position of the denticles and in certain details of the fossa.

Occurrence: The form was found only in the Rockland limestone at Dalrymple and Lakefield, Ontario, and in the Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,289.

Genus *ILDRAITES*, Eller, 1936

Ildraites camurus sp. nov.

Maxilla I, plate II, figs. 30-37.

The jaw is small, wide, and measures from 0.32 mm. to 0.67 mm. in length. Just adjacent to the inner margin a series of seven to ten small, sharp, conical, backward directed denticles extends to the posterior end. The denticles are oblique to the under surface of the jaw. The fang is long, sharp, conical, well hooked, and oblique in its position to the upper side of the jaw. It points in an opposite direction from the denticles. A small bight present on the outer margin emphasizes a small but wide shank. The posterior end of the jaw is narrow, acute and slightly curved. The under surface of the jaw is convex except for the area adjacent to the denticles. A wide, shallow fossa occupies all the upper surface of the jaw except the fang.

There is a general resemblance between *Ildraites camurus* and *I. peramplus* Eller (1942). The two species differ in their width and length and especially in the length of the area posterior to the shank. The fang of *I. camurus* is smaller, thinner and more oblique to the surface of the jaw than *I. peramplus*. There is also a general similarity, though not very close, between *Ildraites* (*Arabellites*) *marcellusensis* (Eller, 1934), *I. bipennis* (Eller, 1936), and *I. camurus*.

Occurrence: *Ildraites camurus* is common throughout the Trenton and was found from Collingwood, Ontario, to Lowville, N. Y.

Types: The holotype is in the Carnegie Museum, number 25,181; paratype no. 25,184. Paratypes have been deposited in the Royal Ontario Museum of Paleontology and in Princeton University.

Ildraites fuehreri sp. nov. *

Maxilla I, plate II, figs. 38-40.

The jaw is subtriangular in outline and measures from 0.89 mm. to 1.21 mm. in length. A series of ten sharp, conical, backward directed denticles extends in a straight line to the posterior end. The denticles, including the fang, are slightly oblique to the under surface of the jaw. The denticles decrease in size gradually to the posterior end. A prominent fang, well hooked, is not in alignment with the other denticles and points in the opposite direction. There is a small space between the fang and the next denticle. The anterior part of the jaw is wide and the posterior extremity is acute, when viewed directly from the under or upper sides. A

shallow but deeply cutting crescent-shaped bight emphasizes the width and shortness of the shank and the narrowness of the posterior end. The margin surrounding the fossa is slightly thickened and rounded. The under surface of the jaw is convex at the shank but flattened or concave adjacent to the denticles.

This form is typical in its general characteristics for the genus, but it does not resemble any particular species closely enough to warrant a synopsis of its relationships.

Occurrence: The type specimen is from Lindsay, Ontario. Other forms were found in the Cobourg (?) at Trenton, Ontario, and in the Denmark, Sherman Fall at Copenhagen, New York.

Types: The holotype is in the Carnegie Museum, number 25,225. A paratype has been deposited in Princeton University.

***Ildraites rarus* sp. nov.**

Maxilla I, plate II, figs. 41-43.

The jaw is wide and angular in outline. On a slightly curved inner margin a series of eleven or twelve sharp, conical, backward directed denticles extends nearly to the posterior end. The denticles are slightly oblique to the under surface and they decrease in size gradually, posteriorly. The fang is large, pointed, and hooked. The second denticle is small and in some specimens the third denticle is of similar size. Measurements of the jaw range from 0.62 mm. to 0.81 mm. in length. On the slightly curved outer margin a wide, deep, crescent-shaped bight forms a long narrow shank and a very narrow posterior area. A shallow fossa occupies most of the upper side of the jaw. The margins of the fossa are rounded and slightly thickened. On the under side, the area between the denticles and the outer margin is concave. The upper side is slightly convex but the jaw as a whole is quite flattened.

Ildraites rarus does not resemble very closely any other species of the genus. The narrowness of the anterior and posterior ends and the shallowness of the jaw mark its difference from other forms.

Occurrence: The figured specimen is from the Rockland near Lindsay, Ontario. Other specimens were found in the Cobourg at Cobourg, Ontario, and in the Hull at Hull, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,243. Paratypes have been deposited in the Royal Ontario Museum of Paleontology and Princeton University.

Genus *LEODICITES*, Eller, 1940

***Leodicites brooksi* sp. nov.**

Maxilla II, plate III, figs. 1-4.

The jaw is wide and short, measuring from 0.29 mm. to 0.52 mm. in length. Measurement of the width of one specimen was 0.52 mm. to a length of 0.38 mm. A series of seven to ten conical, sharp-pointed to blunt denticles extends to the posterior end. The denticles are nearly perpendicular to the under side of the jaw. The fang or first denticle is long, thin, and sharp-pointed and seems to be a part of the anterior margin and shank. The remaining denticles decrease in size only slightly to the posterior. A crescent-shaped bight is present on the lower side of the outer margin and it forms a narrow shank with the anterior margin. The upper side of the outer margin is extended and is usually thin and broken. The side of the jaw adjacent to the narrow shank is concave or flattened; the opposite side is convex. A wide fossa occupies nearly all the upper surface of the jaw. The margin of the under side of the fossa is slightly thickened while the upper one is thin.

There is a general similarity between *Leodicites brooksi* and *Arabellites minutus* Stauffer (1939). The shank and outer margins differ considerably.

Occurrence: *Leodicites brooksi* was found at Lakefield, Ontario, and at Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,249; paratype no. 25,250. Paratypes have been deposited with the Royal Ontario Museum of Paleontology and Princeton University.

***Leodicites biformis* sp. nov.**

Maxilla II, plate III, figs. 5-8.

The jaw is subtriangular in shape and measurements range from 0.62 mm. to 0.78 mm. in length. Along the curved inner margin a series of from ten to twelve large, blunt, backward directed denticles extends to the posterior end. The fang is slightly larger than the other denticles and appears to be a continuation of the anterior margin. The denticles are nearly perpendicular to the under surface and are slightly hooked. The second denticle may be smaller, but the denticles are quite uniform in size, decreasing only slightly to the posterior end. The outer margin is

notched by a broad, crescent-shaped bight which forms a very narrow, pointed shank. An outer margin bears a small, second shank slightly posterior to the principal shank. The anterior margin is straight when viewed from the side. A narrow, deep fossa begins with the shank and extends to the posterior end of the upper side. A slightly thickened margin is present around the fossa. When the jaw is observed from underneath, the right side is concave while the opposite side is convex.

The general characteristics of *Leodicites biformis* resemble *Leodicites acclivis* Eller (1942) and *Lumbriconereites clavatus* Eller (1941).

Occurrence: *Leodicites biformis* was found only in the Rockland. The figured specimen is from Lindsay, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,331.

***Leodicites artus* sp. nov.**

Maxilla II, plate III, figs. 9, 10.

The shape of the jaw is triangular; the length is from about 0.64 mm. to 0.93 mm. Along the curved inner margin a series of twelve or thirteen triangular shaped denticles extends nearly to the acute posterior end. The first denticle is slightly smaller than the following ones and it seems to be an extension of the anterior margin. The denticles increase slightly in width and then decrease in size to the posterior end. All the denticles are directed backward. A slightly curved anterior margin terminates in a short blunt shank. A shallow bight is present on the outer margin and it emphasizes the width and bluntness of the shank. The under side is concave except for an area near the fang. The upper side is highly convex. A deep fossa extends nearly the full length of the jaw. The margin of the fossa is slightly thickened and rounded.

Leodicites artus is similar to *L. summus* Eller (1942) except for the shape of the denticles and shank. The anterior margin of *L. artus* is straighter and the indentation on the outer margin is deeper. Except for the size and arrangement of the denticles and the width of the jaw, *Eunicites hebis* Hinde (1882) resembles *Leodicites artus*.

Occurrence: This form was found only in the Rockland. It was especially common at Lakefield, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,295. Paratypes have been deposited in the collections of the Royal Ontario Museum of Paleontology and Princeton University.

Leodicites semiquadratus sp. nov.

Maxilla II, plate III, figs. 11, 12.

The jaw is wide, angular, and measures from 0.32 mm. to 1.05 mm. in length. Some specimens are as wide as they are long. A series of from eight to twelve sharp-pointed conical denticles extends the full length of the inner margin. Most of the denticles are perpendicular to the inner margin or may point in a slightly forward direction. The denticles decrease in size slightly to the posterior end. The first denticle is long, narrow, and sharp-pointed. A small crescent-shaped bight is present along the lower side of the outer margin and forms a narrow shank with the anterior margin. The upper side of the jaw is very wide and its margin is thin and usually broken. The anterior margin including the fang is straight or slightly incurved. A wide fossa occupies the complete upper part of the jaw. The lower margin of the fossa is thickened and rounded while the upper one is thin and usually broken. The upper side of the jaw between the denticles and the shank is slightly concave; the opposite side of the jaw is convex.

Leodicites brooksi is similar to *L. semiquadratus* in many ways. The two species differ in the character of the shank and indentation on the outer margin and the shape of the fang and anterior margin. *L. semiquadratus* is much more angular in outline and the underside is not as convex as *L. brooksi*.

Occurrence: Specimens were found in the Rockland at Lindsay, Ontario, and in the Middle Trenton near Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,251.

Leodicites antefixus sp. nov.

Maxilla II, plate III, figs. 13, 14.

The jaw is elongate and narrowly subtriangular in outline. The figured specimen measures 0.86 mm. in length. Along the nearly straight inner margin a series of seven large, conical, sharp-pointed, backward directed denticles extends the full length of the jaw. The first denticle is much larger than any of the others. The denticles decrease gradually in size to the posterior end. The anterior margin is slightly incurved. It terminates in a narrow shank which points in a forward direction. From the shank the outer margin curves slightly and then becomes nearly straight to the posterior end. A deep, narrow fossa occupies nearly the full length of the

upper side of the jaw. The margins of the fossa are thickened and rounded. The under side of the jaw is convex.

Arabellites magnificus Stauffer (1939) from the Devonian of Ohio and Ontario, *Leodicites magnificus* (Stauffer), figured by Eller (1940) from the Windom of New York, and *L. barbatus* Eller (1942) from the upper Ordovician of Ontario are similar to *L. antefixus* in outline. The shape of the fossa and the size and arrangement of the denticles of *L. antefixus* differ from those species.

Occurrence: The figured specimen is from the Rockland at Kirkfield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,436.

***Leodicites ? continuus* sp. nov.**

Maxilla II or III, plate III, figs. 15, 16.

The jaw is short and subtriangular in shape. The figured specimen measures 0.35 mm. in length. A series of seven sharp, conical denticles of various sizes are present along the inner margin. The first denticle is a continuation of the straight anterior margin. The next three denticles increase in size to about the mid-area where they become smaller to the posterior end. All denticles are nearly perpendicular to the straight ones. On the outer margin a small flange is present in the posterior half of the jaw. A shallow bight emphasizes the smallness of the flange. All of the upper side of the jaw is occupied by a deep but narrow fossa. The margins of the fossa are rounded and rather thin. The sides of the jaw are irregularly convex.

Leodicites ? continuus does not resemble other forms very closely and it was questionable under just what genus it should be placed. The presence of a shank and bight, although very small and not exactly in the usual position, places the species in the genus *Leodicites* rather than in *Ænonites* or *Staurocephalites*.

Occurrence: The figured specimen is from the Rockland at Belleville, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,357.

***Leodicites collatatus* sp. nov.**

Maxilla III, plate III, figs. 17, 18.

The jaw is elongate and angular except for the right outer margin which is gently incurved. The figured specimen measures 0.48 mm. in length.

A series of six blunt, triangular shaped denticles extends along the curved inner margin to the posterior end. The anterior end is extended forward to a pointed shank. The posterior extremity is acute and rounded. A shallow fossa occupies the upper side of the jaw and extends into the shank. The margins of the fossa are slightly thickened. On the under side and adjacent to the denticles the jaw is slightly concave.

The forward directed anterior end or shank is unlike any other species of this genus. *Leodicites convallis* is similar except for the backward directed shank.

Occurrence: The figured specimen is from the Rockland at Paquette Rapids, Ottawa River, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,630.

***Leodicites exilis* sp. nov.**

Maxilla II, plate III, figs. 19, 20.

The jaw is small, subtriangular in outline with a straight anterior margin and a narrow blunt posterior end. The figured specimen measures 0.48 mm. in length. A series of eleven conical, sharp-pointed, backward directed denticles extends nearly the full length of the jaw. The first denticle is smaller than the second. The remaining denticles decrease in size gradually to the posterior end. A large bight occupies the inner side of the jaw and forms a narrow, slightly angular shank with the anterior margin. A narrow fossa extends the full length of the jaw and also extends into the shank. The upper side of the jaw is convex while the under side is flattened or slightly concave.

Except for the denticles, *Leodicites exilis* is similar to *L. reimanni* Eller (1941). There is a slight resemblance between *L. creditensis* Eller (1942) and *L. exilis*. *Eunicites anchorales* Eller (1934) is like *Leodicites exilis* in outline except at the anterior end and the character of the denticles. *Eunicites hebes* Hinde (1882) figure 9, is quite similar to *Leodicites exilis* in outline and differs only slightly in its details.

Occurrence: The figured specimen is from the Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,363.

***Leodicites arquatus* sp. nov.**

Maxilla II, plate III, figs. 21, 22.

The jaw is subtriangular in outline, wide anteriorly and tapers to an acute posterior end. The anterior margin is incurved. On the inner mar-

gin, a series of six or seven large, conical, sharp-pointed, backward directed denticles extends to the posterior extremity. The first denticle or fang is large and hooked. The denticles decrease in size uniformly. The outer margin is notched by a bight at the anterior end which makes a narrow arched shank. Posteriorly the outer margin is straight. A narrow, deep fossa begins in the shank and continues to the posterior end. The margins of the fossa are very thick and rounded. The under surface is flattened and the upper surface is convex. In length the form measures from 0.32 to 0.43 mm.

While *Leodicites arquatus* resembles several species of the genus, the anterior margin and the character of the fossa distinguishes it from them.

Occurrence: This species was found in the Rockland at Lindsay and Dalrymple, Ontario, and in the Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,240.

***Leodicites agostini* sp. nov.**

Maxilla II, plate III, figs. 23, 24.

The jaw is triangular in outline and measures about 0.7 mm. in length. A series of nine or ten large, conical, sharp-pointed denticles extends the full length of the jaw. The denticles are mostly perpendicular to the inner margin and decrease in size to the posterior end. The first denticle or fang is large and is a continuation of the short, straight anterior margin. A shallow bight is present on the inner margin and it forms a small, forward-pointing shank. The fossa is angular, deep and occupies the entire outer side. A thick, well rounded margin is present and surrounds the fossa. Both the upper and under sides are irregularly convex.

Leodicites agostini does not resemble any other form very closely and no comparison will be made at this time.

Occurrence: The quarry at Lakefield, Ontario, is considered to be of Rockland age. The figured specimen came from this locality.

Type: The holotype is in the Carnegie Museum, number 25,248.

***Leodicites anticus* sp. nov.**

Maxilla II, plate III, figs. 25, 26.

In outline the jaw is subtriangular, wide anteriorly and posteriorly. The width and length of the jaw are nearly equal. The figured specimen measures 0.38 mm. in length. A series of nine sharp to blunt denticles

extends along the curved inner margin and around the posterior end. The first denticle or fang is large, conical and points in a forward direction. The second denticle is small and conical. The remaining denticles are large and blunt and decrease in size to the posterior end. The four posterior denticles are hooked toward the under surface of the jaw. The anterior margin is incurved from the fang to the shank, which curves forward. From the shank to the posterior end the outer margin is slightly incurved. The under side of the jaw is convex except at the posterior end, adjacent to the denticles, where it is concave or flattened; the opposite side is convex. A deep, narrow fossa extends along the outer margin nearly the full length of the jaw. The margin of the fossa is thickened and rounded.

This form is similar to *Leodicites streetsvillensis* Eller (1942), except for the shape of the shank and posterior end. There is also a slight resemblance between *L. caleyi* Eller (1944) and *L. anticus*.

Occurrence: The figured specimen was found in the Rockland at Gamebridge, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,270.

***Leodicites absolutus* sp. nov.**

Maxilla II, plate III, figs. 27-29.

In outline the jaw is subtriangular. The jaw is wide and the figured specimen measures 0.64 mm. in length. A series of sixteen small, blunt denticles extends in a curved line the full length of the jaw. The fang is sharp, conical and hooked. The first three denticles following the fang are of medium size; the remainder are small and compact. The denticles are nearly perpendicular to the under side of the jaw. The inner margin is curved anteriorly, but becomes nearly straight in the posterior half. The outer margin is notched by a crescent-shaped bight which forms a wide, blunt shank. The under surface is concave between the denticles and the shank. A wide, shallow fossa occupies about three-quarters of the upper surface of the jaw. The margin of the fossa is thickened and rounded.

Leodicites absolutus does not closely resemble the other species of the genus. Its width and the curvature of the margins are unlike other forms.

Occurrence: The figured specimen was found in what is said to be the Selby member of the Rockland at Lowville, New York, on Mill Creek at the State Street bridge.

Type: The holotype is in the Carnegie Museum, number 25,245.

***Leodicites angustisulcus* sp. nov.**

Maxilla II, plate III, figs. 30-32.

The jaw is narrow and angular in outline. The figured specimen measures 0.86 mm. in length. A series of eleven flattened, slightly conical, backward directed denticles extends the full length of the jaw. The first denticle is short, wide, and points in a forward direction. The second is large and is followed by a small one. The next two or three denticles are large and the remaining ones decrease in size rapidly to the posterior end. The inner margin is irregularly curved. The outer margin is notched by a deep crescent-shaped bight which forms a narrow shank with the anterior margin. A narrow but deep fossa extends the full length of the jaw and the shank. The margins of the fossa are slightly thickened and rounded. The under surface of the jaw is irregularly convex.

Leodicites angustisulcus resembles very closely *L. acclivis* Eller (1942). The two species differ in the width of the fossa, length of the shank, and the shape and arrangement of the denticles.

Occurrence: The type is from the Middle Trenton at St. Maurice Quarry north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,518.

***Leodicites breviculus* sp. nov.**

Maxilla II, plate III, figs. 33-37.

The jaw is small, measuring in length from 0.29 mm. to 0.62 mm. A series of six to eight long, conical, sharp-pointed, backward directed denticles extends the full length of the slightly curved inner margin. The second denticle may be smaller but the remaining ones are large and decrease in size gradually to the posterior end. All the denticles are slightly hooked and are nearly perpendicular to the under side. The fang is about the same size as the larger denticles and appears to be a continuation of the anterior margin. The inner margin is irregular in outline. A crescent-shaped bight is present on the outer margin; it forms a small acute shank with the anterior margin. The posterior end is acute, while the anterior end is broad and incurved. A triangular-shaped fossa occupies the upper surface including the shank. The margins of the fossa are thickened and rounded. The under side is generally convex, with concave areas adjacent to the denticles.

Leodicites breviculus resembles *L. acclivis* Eller (1942) and *Lumbri-*

conereites clavatus Eller (1941) in a general way. *L. breviculus* and *L. biformis* are quite similar except for the character of the denticles and the anterior end and shank.

Occurrence: The geological and geographical distribution of *L. breviculus* is extensive. The species is found from Collingwood, Ontario, to Watertown, New York.

Type: The holotype is in the Carnegie Museum, number 25,228.

***Leodicites clementi* sp. nov.**

Maxilla II, plate III, figs. 38-40.

The jaw is subtriangular and measures in length from 0.32 mm. to 0.75 mm. A series of from seven to nine conical denticles extends the full length of the curved inner margin. The denticles are nearly perpendicular to the under surface. The fang is long, thin, and pointed and is a continuation of the straight thickened anterior margin. The denticles decrease gradually in size to the posterior end. On the outer margin a deep crescent-shaped bight is present, which forms, with the anterior margin, a narrow shank. The area adjacent to the shank is concave, while the opposite side of the jaw is highly convex. A narrow, deep fossa occupies most of the upper side of the jaw. The margins of the fossa are thickened and rounded.

Except for the shape and arrangement of the denticles there is a general similarity between *Leodicites clementi* and *Arabellites magnificus* Stauffer (1939).

Occurrence: This form was found throughout the Trenton formation. It was common in the Rockland at Lakefield, Ontario, and was found in the Sherman Fall at Henderson, New York, the Hallowell member of the Cobourg at Copenhagen, New York, and in the Denmark of the Sherman Fall at Trenton Falls, New York.

Types: The holotype is in the Carnegie Museum, number 25,297. A paratype is in the collection of Princeton University.

***Leodicites buris* sp. nov.**

Maxilla II, plate III, figs. 41-43.

In outline the jaw is narrowly subtriangular with gracefully curved margins. Specimens measure in length from 0.72 mm. to 1.08 mm. A series of ten to twelve blunt, triangular-shaped denticles extends to the posterior end. The first denticle or fang is small and hooked. The second

denticle is very large and it is followed by a minute tooth. The remaining denticles are large and decrease in size to the posterior end. The inner margin is broadly curved anteriorly and forms a wide, triangular-shaped area when viewed from the side. A crescent-shaped bight is present on the outer margin and it forms, with the anterior margin, a narrow hooked shank. The anterior margin is gently rounded and the posterior end is acute. The under side is convex except at the anterior, where it is flattened or slightly concave. A narrow irregular fossa occupies most of the upper side. The margins of the fossa are slightly thickened and rounded.

There is a general similarity between *Leodicites buris* and *L. acclivis* Eller (1942). The shape and arrangement of the denticles and the shape of the margins and fossa are different. *L. breviculus* is somewhat similar to *L. buris* when viewed from the under side.

Occurrence: The species is limited to the Cobourg and found at Collingwood and Cobourg, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,321, and a paratype is in the Royal Ontario Museum of Paleontology.

***Leodicites bisulcus* sp. nov.**

Maxilla II, plate III, fig. 44.

The jaw is small and subtriangular in shape. The figured specimen measures 0.29 mm. in length. Along the arched inner margin a series of about fifteen small, conical, sharp-pointed, backward directed denticles extends the full length of the jaw. The first four denticles are about the same size while the remaining ones are minute and do not decrease appreciably in size to the posterior end. The curved anterior margin is notched, forming two small shanks. A shallow bight on the outer margin emphasizes the shortness of the shanks. A narrow fossa begins between the two shanks and occupies the full length of the outer side of the jaw. The margins of the fossa are rounded and slightly thickened. The upper surface of the jaw is convex while the under surface is concave or flattened.

L. bisulcus has more and smaller denticles than observed in most species of *Leodicites*. The notched anterior end has not been found in any other form of this genus.

Occurrence: The figured specimen is from the Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,356.

Leodicites angulus sp. nov.

Maxilla II, plate III, fig. 45.

In outline the jaw is subtriangular with nearly straight margins. The form measures from 0.62 mm. to 0.86 mm. in length. Along the inner margin a series of sharp, conical, irregularly shaped, backward directed denticles extends to the posterior end. The first denticle is small and slightly hooked. The second denticle is large and thickened, while the third denticle may be small. The remaining denticles decrease in size to the posterior end and are very much backward directed. The anterior margin is nearly straight. On the outer margin an angular bight forms a shank with the anterior margin. The shank has blunt or square ends and does not seem to be broken. The under side of the jaw is convex, except for a slight indentation along the anterior margin. A large fossa extends nearly the full length of the upper surface of the jaw.

There is a resemblance between *Leodicites barbatus* Eller (1942) from the Meaford, Upper Ordovician of Streetsville, Ontario, and *L. angulus*. The angular outline of the jaws and the arrangement of the denticles are similar, but the species differs in the angle of the shank and the shape and size of the fossa.

Occurrence: The species was found in the Rockland and in the Cobourg. The figured specimen is from Collingwood, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,343, and a paratype is in Princeton University.

Leodicites convallis sp. nov.

Maxilla II or III, plate IV, figs. 1-3.

The jaw is elongate, rounded, and with nearly parallel sides. The anterior end is wide and rounded while the posterior tapers abruptly to an acute end. A series of eight to twelve conical, blunt to sharp-pointed, backward directed denticles extends the full length of the jaw. The first denticle is long and narrow and is followed by smaller teeth that decrease only slightly to the posterior end. A large, deep, round bight is present on the inner margin. It forms a thin, nearly straight shank with the anterior margin. The upper side of the jaw including the shank is occupied by a deep fossa. The margins of the fossa are thickened and rounded. The under side of the jaw is highly convex. The figured specimen measures 0.48 mm. to 0.71 mm. in length.

There is a slight resemblance in outline between *Leodicites acclivis* Eller (1942) and *L. convallis*. The denticles of the two species differ widely.

Occurrence: The figured specimens are from the Rockland, which outcrops in a low escarpment about three miles north of Lindsay, Ontario, and from the Trenton north of Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,373; also a paratype, number 25,517.

***Leodicites corbis* sp. nov.**

Maxilla III, plate IV, figs. 4, 5.

The jaw is large and wide, anteriorly, but narrows abruptly at the mid-area and terminates in an acute posterior ending. A series of ten to twelve blunt denticles extends to the posterior end along the curved inner margin. The denticles gradually decrease in size posteriorly. A shallow, round bight is present on the inner margin. It forms a small shank with the broadly rounded anterior margin. On the upper side of the jaw a deep fossa occupies the complete area including the shank. The margins of the fossa are slightly thickened. On the under side of the jaw the surface to the right of the denticles is gently convex to flattened; the left side is slightly concave. The figured specimen measures 0.99 mm. in length.

Leodicites corbis does not resemble any other species of this genus very closely due to the broadly rounded anterior end.

Occurrence: The figured specimen is from the Rockland at Paquette Rapids on the Ottawa River, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,631.

***Leodicites creditensis* ? Eller**

Maxilla II.

Leodicites creditensis Eller, 1942, *Annals, Carnegie Museum*, vol. xxix, pp. 257, 258, pl. 3, figs. 9, 10.

In the Meaford, Upper Ordovician at Streetsville, Ontario, *Leodicites creditensis* Eller was very common. Specimens identified as this species were found in the Trenton and were common at Dalrymple and at Kirkfield, Ontario. Duplicate specimens have been deposited in the Royal Ontario Museum of Paleontology and Princeton University.

Genus *STAUROCEPHALITES*, Hinde, 1879

***Staurocephalites appositus* sp. nov.**

Maxilla II, plate IV, figs. 6-9.

The jaw is elongate, broadly rounded anteriorly, and tapers to a narrow truncate posterior end. The figured specimens measure 0.59 and 0.64 mm. in length. Along the inner margin a series of fourteen to sixteen triangular shaped backward directed denticles extends nearly the full length of the jaw. The first six or seven denticles are sharp-pointed while the remaining ones are blunt. In the anterior third of the jaw, adjoining or bordering upon the above described teeth, is a small jaw or a group of minute denticles arranged in a small arc. There is a deep cavity between the two rows of adjacent denticles. This second row of denticles is probably a separate jaw closely articulated to the larger one. It is difficult to find, however, a suture or line of articulation between the two jaws. The upper side of the jaw is completely occupied by a fossa. The margins of the fossa are slightly thickened at the anterior end. The under side of the jaw is highly convex.

A number of specimens were found in this deposit having more than one row of denticles. The deep cavity between the row of denticles suggests that the form is made up of two separate jaws which must have been closely articulated during life. It is not an accident of preservation since several specimens were found. In outline and other characteristics the form resembles very closely *S. nettingi* except for the size and arrangement of the denticles.

Occurrence: The figured specimens are from the Rockland at Kirkfield, Ontario, and the Middle Trenton near Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,428; also a paratype, number 25,489.

***Staurocephalites kayi* sp. nov.**

Maxilla II, plate IV, figs. 10, 11.

The jaw is small, elongate, and its long axis is slightly curved. On the inner margin a series of ten sharp, conical shaped, backward directed denticles extends to the posterior end. The first denticle is slightly larger and appears, when viewed from the side, to be a continuation of the margins. A slightly flattened or concave area is formed just posterior to the first denticle or fang. The anterior end of the jaw is wide to a point about midway where it narrows abruptly and terminates in an acute posterior

extremity. The margins are usually broken but have a tendency to be slightly thickened. A large wide fossa occupies the complete upper surface of the jaw and is deep in the center toward the denticles but shallow and flattened at the margins. The length of the average jaw is 0.32 mm.

There is a slight similarity between *Staurocephalites dentatus* Stauffer (1933) and *S. kayi* in the anterior area but in most characteristics they differ. A specimen described by Stauffer (1939) from the Olentangy shale, Marsh's Mill, Ontario, as *Lumbriconereites* sp. (fig. 5) is similar to *S. kayi* in a general way but differs in the width of the jaw, the number of denticles, and the anterior ends.

Occurrence: The figured specimen is from a small quarry about four miles north of Peterborough. This form was also found at Paquette Rapids, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,151.

***Staurocephalites aduncus* sp. nov.**

Maxilla II, plate IV, figs. 12, 13.

The jaw is wide and rounded anteriorly and narrows abruptly to an acute posterior end. A typical specimen measures 0.56 mm. in length. Eight large, conical, sharp-pointed, backward directed denticles extend to the posterior extremity. The first two denticles are small but they increase in size to the mid-area and then decrease slightly in size to the posterior end. The margin bearing the denticles curves at the anterior end and forms a concave area on the inside of the curve. The under side is convex. A large, deep fossa occupies the upper side of the jaw. The margins of the fossa are only slightly thickened.

Ænonites excavatus Eller (1941) is similar to *Staurocephalites aduncus* except for the denticles and the depth of the fossa and the character of the margins around the fossa.

Occurrence: The figured specimen is from a small quarry, considered to be Rockland, near Millington, Ontario County, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,267.

***Staurocephalites (?) arcus* sp. nov.**

Maxilla III, plate IV, figs. 14, 15.

In comparison with the size of denticles the jaw is narrow and short. The described specimens measure 0.48 mm. and 0.64 mm. in length. A series of twelve to fifteen sharp, conical, backward directed denticles ex-

tends the full length of the jaw. The denticles are slightly hooked. At the anterior end the denticles are small and increase gradually to a large size at the mid-area, then decrease to the posterior end; the last three denticles are minute. One side of the jaw is flattened and the opposite side is convex. The margins of the sides of the jaw or fossa are incurved and thickened. A narrow, deep fossa occupies the upper side of the jaw.

Eunicites validus Eller (1938) is similar to *Staurocephalites* ? *arcus* in a general way. The margins and denticles differ in the two species. *Lumbriconereites arcuatus* Stauffer (1933) resembles closely *Staurocephalites arcus*. The two forms differ in the character of the denticles and the shape of the anterior ends.

Occurrence: *Staurocephalites* ? *arcus* was found in the Rockland at Lakefield, Ontario, in the Upper Cobourg at Collingwood, Ontario, and in the Middle Trenton at Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,293; also a paratype, number 25,540.

***Staurocephalites admirabilis* sp. nov.**

Maxilla II, plate IV, figs. 16-18.

In size the jaw is large, measuring probably 2 mm. in length. A specimen (fig. 16) is 0.99 mm. Along the inner margin a series of twenty-five long, conical, sharp-pointed, backward directed denticles extends to the posterior extremity. The first few denticles are smaller than those of the mid-area, which are uniform in size. In the posterior third the inner margin curves outward and the denticles increase in length, and then decrease rapidly in size to the posterior end. Most of the denticles are slightly hooked. The denticles, at their base, continue into the lower surface of the jaw as ridges. From the upper side these ridges are visible through the thin jaw as furrows. This gives the side of the jaw a corrugated appearance. The areas on both sides of the denticles are flattened or slightly concave. The anterior end of the jaw is rounded and the posterior end is pointed. A wide, shallow fossa occupies nearly the complete upper side of the jaw. The margin of the fossa is thickened and rounded.

Except in a general way there is not enough similarity between this species and others of the genus to warrant comparisons.

Occurrence: *Staurocephalites admirabilis* was found only in the Cobourg at Collingwood, Ontario, and in the Rockland at Kirkfield, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,323; likewise a paratype, number 25,324.

Staurocephalites ? absimilis sp. nov.

Maxilla II or III, plate IV, figs. 19, 20.

The jaw is long, narrow, and measures 0.59 mm. in length. Along the curved inner margin a series of fifteen long, conical and sharp-pointed denticles extends the full length of the jaw. The first four or five denticles are longer than the width of the jaw. The remaining denticles are smaller and wider at the base. They decrease in size gradually to the posterior end. For the most part the denticles are perpendicular to the inner margin of the jaw. The anterior margin is blunt and the lateral irregularly curved margins taper to an acute posterior extremity. A fossa occupies the complete upper surface of the jaw. The margins of the fossa are thin.

The species does not resemble other forms very closely. *Staurocephalites serrula* Hinde (1880) is similar in a general way to *S. absimilis*.

Occurrence: The form was found in the Rockland at Lakefield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,354.

Staurocephalites bijugus sp. nov.

Maxilla II, plate IV, figs. 21-23.

The jaw apparatus consists of two parallel rows of denticles of equal length. The denticles of both rows are sharp-pointed, backward directed, and equal in number. The anterior end is rounded while the posterior end is slightly truncate. A fossa extends the full length of the upper side. When the form is observed from the under side there is a faint trace of articulation but it cannot be definitely described or illustrated. There is no line of articulation visible from the upper side in the fossa. The jaw measures 0.52 mm. in length.

This form is probably made up of two jaws that have become so closely adhered to each other that any seam between them is difficult to detect. It is interesting to note that there is no partition in the fossa.

Occurrence: The figured specimen is from the Middle Trenton at the St. Maurice Quarry north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,500.

Staurocephalites cuneiformis sp. nov.

Maxilla III, plate IV, fig. 24.

The jaw is small, rounded or blunt anteriorly, and tapers to an acute posterior end. The figured specimen measures 0.35 mm. in length. Along the straight inner margin a series of five or six conical, sharp-pointed,

backward directed denticles extends the full length of the jaw. The first denticle is slightly larger than the remaining denticles and is situated some distance from the anterior margin. All the denticles are large for the size of the jaw. The area around the first denticle is somewhat concave or flattened. A fossa occupies the upper side of the jaw. The margins of the fossa are thin and usually broken.

Staurocephalites cuneiformis resembles in a general way *S. aduncus* and *S. agriodos* described in this paper.

Occurrence: The form was found in the Selby of the Rockland at Lowville, New York, and in the Rockland at Belleville, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,355.

***Staurocephalites absis* sp. nov.**

Maxilla III, plate IV, fig. 25.

The jaw is short and wide with broadly rounded ends. A series of nine large, conical, sharp-pointed denticles extends the complete length of the jaw. The first denticle is small and they increase in size to the mid-area, where they become smaller, to the posterior extremity. The denticles are arranged in a curved arc. The surface adjacent to the inside of the arc is slightly concave; the opposite side is convex. A deep, narrow fossa extends the full length of the upper side. Its margins are thickened and rounded. A described specimen is 0.56 mm. in length.

Staurocephalites absis is similar to *Eunicites validus* Eller (1938) in a general way. The two species differ in the curvature of the arc and the size of the denticles. The areas on both sides of *Eunicites validus* are convex while the inner side of *Staurocephalites absis* is concave. Except for the length and number of denticles, *Lumbriconereites arcuatus* Stauffer (1933) is like *Staurocephalites absis*.

Occurrence: Along the Pretty River, east of Collingwood at Georgian Bay, Ontario, the Cobourg crops out. The limestone is thin bedded, argillaceous, rubblely, and weathers gray. Jaws were plentiful at this locality. The form was also found in the Cobourg at Cobourg, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,164.

***Staurocephalites ? triplus* sp. nov.**

Maxilla II, plate IV, figs. 26-28.

The jaw is narrow and elongate with three separate rows of denticles. A series of nineteen sharp, conical, backward directed denticles extends the

full length of the jaw. The anterior denticles are large but decrease suddenly in size at the posterior end. In the anterior half of the jaw a second series of sharp, conical denticles, parallel to the principal row, extends nearly to the mid-point. These denticles are on the left-hand side of the jaw when it is observed from the under side. On the right side, at the posterior end, a highly arched ridge bearing a series of thirteen sharp, minute denticles extends to the end of the jaw. Both the anterior and posterior ends are truncate. A shallow fossa is present the full length of the upper surface. The described specimen is 0.75 mm. in length. No definite suture of articulation is noticeable between the rows of denticles on either the upper or under sides of the jaw.

It is probable that this form is made up of three different segments of jaws very closely articulated. The second row of denticles at the anterior end of the jaw is quite conceivable when one considers the arrangement of the jaw apparatus in some of the modern forms. The row of denticles or small attached jaw at the posterior third is not so easily explained or imagined. It is interesting to note the similarity of the two rows of denticles in the posterior end.

Occurrence: The described specimen came from a quarry two miles north of Belleville, on the road to Foxboro, Ontario. The dark limestone in the quarry is probably Rockland in age. It is about ten feet thick and rests on shale.

Type: The holotype is in the Carnegie Museum, number 25,212.

***Staurocephalites agriodos* sp. nov.**

Maxilla III, plate IV, figs. 29, 30.

The jaw is elongate, obliquely truncate at the anterior end, and tapers to an acute posterior extremity. The figured specimen measures 0.54 mm. in length. Along the inner margin, a series of sharp-pointed, conical denticles extends the full length of the jaw. The first denticle is very large and slightly hooked. The next four denticles are large and of nearly the same size. The remaining denticles are very small. All denticles point in a backward direction. The outer margins are incurved while the inner margin bearing the denticles is arched. A fossa occupies the complete upper surface of the jaw. The margins of the fossa are thickened and rounded.

There is a slight resemblance between *Staurocephalites agriodos* and *S. aduncus*. *Enonites excavatus* Eller (1941) is similar to *S. agriodos* except for the shape of the anterior end and the character of the denticles.

Occurrence: The figured specimen is from the Rockland at Kirkfield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,353.

***Staurocephalites nettingi* sp. nov.**

Maxilla II, plate IV, fig. 31.

The jaw is long, wide anteriorly, narrow posteriorly and measures from 0.64 mm. to 1.21 mm. in length. A series of from eighteen to twenty-one denticles extends along the inner margin to the posterior extremity. The first seven or more denticles are sharp, conical and backward directed. They extend to just beyond the mid-point. The remaining denticles rapidly become small or minute. Toward the posterior end they are rather blunt and uniform in size. The margins are irregular and thin. In some specimens the margins were translucent. The anterior margin is usually broadly curved but may be straight and obliquely truncate to the outer margin. The posterior end is narrow and rounded. The left outer margin is parallel to the margin bearing the denticles. A large, deep fossa, wide anteriorly, narrow posteriorly, extends the complete length of the jaw. The under side is convex except at the anterior end, which is flattened or may be slightly concave.

Staurocephalites nettingi is similar to other species of this genus only in a general way. This species is one of the most common in the fauna. The abrupt change from the large denticles to the very small ones is apparent in nearly every specimen.

Occurrence: *Staurocephalites nettingi* was found only in the Rockland. It is very common at Lakefield, Ontario, and occurs from Millington, Ontario, to Lowville, New York. This species was also found at Paquette Rapids, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,309. Paratypes are in the collections of Princeton University and the Royal Ontario Museum of Paleontology.

***Staurocephalites mierowae* sp. nov.**

Maxilla II, plate IV, figs. 32, 33.

The jaw is elongate, irregular in outline, and measures 0.52 mm. in length. On the inner margin a series of fourteen large, conical, sharply-

pointed denticles extends the full length of the jaw. The denticles are nearly uniform in size and are perpendicular to the margin, except at the posterior end where the last three or four denticles are bent backwards. The first denticle is slightly larger, especially at the base. The anterior and posterior ends are both acute. The outer margins are broken but there is evidence that they were slightly thickened. A deep but narrow fossa extends the full length of the upper side of the jaw.

This species is not closely similar to any other form. The uniformly large denticles, especially the posterior ones, are a contrast to most species of this genus.

Occurrence: The figured specimen is from the quarry of the Canada Cement Company at Lakefield, Ontario. The age is probably Rockland.

Type: The holotype is in the Carnegie Museum, number 25,199.

***Staurocephalites heppenstallae* sp. nov.**

Maxilla II, plate IV, figs. 34, 35.

The jaw is narrow, elongate, and slightly curved along its horizontal axis. Measurement of the length of the figured specimen is 0.43 mm. A curved inner margin bears a series of eight sharp, conical, backward directed denticles and six or more round, minute ones which extend nearly to the posterior end. The anterior end of the jaw is obliquely truncate and forms an acute point. The outer margins are curved and a small indentation is present at the anterior end. The margins are slightly thickened. The under surface is generally convex but shallow concave areas are present near the denticles and especially at the anterior part. A large deep fossa, wide anteriorly and narrow posteriorly, is present along the complete length of the upper side of the jaw. The posterior end is rounded.

Staurocephalites heppenstallae is quite similar to *S. dentatus* Stauffer (1933), fig. 32, especially at the anterior part. The denticles in the posterior area are different. It is difficult to draw any additional conclusions since only one view of *S. dentatus* Stauffer is shown.

Occurrence: The figured specimen is from the Hull at Hull, Quebec. The form was common from the Cobourg at Collingwood to the Selby of Rockland age at Lowville, New York.

Types: The holotype is in the Carnegie Museum, number 25,145. Paratypes are in Princeton University and the Royal Ontario Museum of Paleontology.

***Staurocephalites paquetensis* sp. nov.**

Maxilla II, plate IV, figs. 36-38.

The jaw is elongate, wide anteriorly and narrowing abruptly at the mid-point. The posterior end is truncate. A complete specimen measured 1.37 mm. in length, while a broken one probably measured 1.5 mm. Along the inner margin a series of from fourteen to twenty sharp, triangular shaped, backward directed denticles extends to the posterior extremity. The first denticle and sometimes the second one are parallel with the broad anterior margin. The second denticle is usually smaller than the first or third denticle. From the anterior to the posterior end the denticles decrease in size uniformly. The left outer margin is parallel to the row of denticles. The right outer margin is incurved at about the mid-area. A large fossa occupies the complete upper side of the jaw. The margins of the fossa are thin and irregular.

Staurocephalites nettingi is similar to *S. paquetensis*. They differ in the size and arrangement of the denticles and the width of the anterior end. *S. paquetensis* resembles *S. externus* Eller (1944) except for the width of the anterior end.

Occurrence: The figured specimens are from the Rockland at Paquette Rapids, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,636; also a paratype, number 25,637.

***Staurocephalites mcallae* sp. nov.**

Maxilla II, plate VII, fig. 24.

The jaw is elongate and measures 1.53 mm. in length. On the lower surface a series of seventeen large, sharp, conical, backward directed denticles extends to the posterior end. The first denticle is smaller and parallel to the anterior margin and second denticle. From the anterior end the denticles increase in size slightly to about the mid-point and then decrease in size gradually to the very small ones at the posterior extremity. The anterior end is narrow but truncate. The posterior end is broadly rounded. Both margins are thin and broken. The fossa extends the full length of the jaw and is narrow and deep.

An additional characteristic of the genus *Staurocephalites* is the tendency of the margin bearing the denticles to curve at the anterior end. In *Staurocephalites mcallae*, only one denticle is out of alignment with the others, but in many species several may be.

Occurrence: About three miles north of Lindsay, Ontario, the highway, route 35, cuts an escarpment and exposes from ten to fifteen feet of thin bedded limestone which is perhaps Rockland in age.

Type: The holotype is in the Carnegie Museum, number 25,155.

Genus *ÆNONITES*, Hinde, 1879

Ænonites adversus sp. nov.

Maxilla II, plate V, fig. 1.

The jaw is small, wide anteriorly, and tapers to a narrow posterior end. In length, the figured specimen measures 0.48 mm. A series of about twenty sharp-pointed, conical denticles extends the full length of the jaw. The first two denticles are large and point forwards. The remaining denticles are minute and point in a backward direction. At about the mid-point, the denticles reverse their position and are directed toward the outer side. A small, narrow fossa is present in the posterior half of the jaw. The margins of the fossa are rounded. The under side of the jaw is convex while the upper side is flattened or slightly concave.

In some characters this species might be placed under the genus *Ildraites*. It does not, however, have the typical flange, deep indentation on the outer margin, or a typical fossa. *Ildraites exquisitus* Eller and *I. fritzae* Eller (1942) are forms that suggest the relationship to *Ildraites*. *Ænonites parvidentatus* Eller (1940) is similar to *Æ. adversus* in outline. *Æ. curvidens* Hinde (1882), fig. 32, resembles *Æ. adversus* rather closely except for the character and arrangement of the denticles.

Occurrence: The figured specimen is from the Upper Cobourg at the eastern part of Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,372.

Ænonites ? intrinsecus sp. nov.

Maxilla II, plate V, fig. 2.

The jaw is small, wide anteriorly, and tapers to a blunt posterior. The figured specimen measures 0.35 mm. in length. A series of ten sharp-pointed, conical, slightly hooked denticles extends nearly to the posterior end. The inner margin bearing the denticles is slightly incurved. The first denticle is a little larger than the other denticles and it appears to be a continuation of a ridge that extends the full length of the jaw. The area between the denticles and the ridge is concave. All the denticles point slightly backwards and are nearly uniform in size. A narrow fossa ex-

tends the full length of the jaw. The margin of the fossa is thin and may be broken. The under side is convex and is extended beyond the outer margin of the upper side.

The shape of the fossa is not like most forms of *Ænonites*. There is a slight resemblance between *Æ. intrinsecus* and *Æ. henryi*. Hinde (1882) described a number of specimens as *Æ. naviformis* that are similar to *Æ. intrinsecus* in a general way.

Occurrence: The figured specimen is from the Rockland at Dalrymple, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,358.

***Ænonites fissilis* sp. nov.**

Maxilla I, plate V, figs. 3, 4.

The jaw is small, narrow and elongate. It measures from 0.52 mm. to 0.72 mm. in length. A series of eight to twelve small, sharp-pointed, conical denticles extends about two-thirds the length of the jaw. The fang is long, sharp and slightly angular. The first two or three denticles are small and point in a forward direction. The remaining denticles are backward directed and decrease gradually in size to the posterior end. A deep fossa begins opposite the first denticle and extends to the end of the jaw. The margins of the fossa are thickened and rounded. The upper side of the jaw is slightly concave adjacent to the denticles. The under side is irregularly concave and convex. Near the posterior end a small notch is present that is emphasized by a groove that extends for a short distance parallel to the sides of the jaw.

Ænonites franci Eller (1940) very slightly resembles *Æ. fissilis*. There is a similarity between *Æ. sinuatus* Eller (1942) and *Æ. fissilis*. The two forms differ in the length of the fang and the shape of the fossa. Except for the arrangement of denticles, *Æ. serratus* Hinde (1879) is similar to *Æ. fissilis*.

Occurrence: The species occurs generally through the Trenton and has wide geographical distribution.

Type: The holotype is in the Carnegie Museum, number 25,282.

***Ænonites ? dubius* sp. nov.**

Maxilla II or III, plate V, figs. 5, 6.

The jaw is triangular in shape, wide anteriorly, and tapers to an acute posterior extremity. The figured specimen measures 0.39 mm. in length.

On the inner margin, a series of eight blunt, elongate denticles extends the full length of the jaw. The first denticle is the largest and the remaining teeth decrease in size gradually to the posterior end. One outer margin is thin and broken while the other is extended to a blunt point at about the mid-area. The anterior margin is straight or slightly incurved. A large shallow fossa occupies nearly all of the upper side of the jaw. The margin of the fossa nearest the denticles is flat, wide, and slightly thickened. The underside of the jaw is convex except for the flattened area adjacent to the denticles.

When this species is observed from the upper side it resembles species of the genus *Leodicites*. The underside, bearing the denticles, is not like that of any species of *Leodicites*. The form does not, however, fit very well in the genus *Ænonites*. In 1940, the writer described *Ænonites triangulus* which is in a general way slightly similar to *Æ. dubius*.

Occurrence: The form was common in the Rockland at Kirkfield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,375.

***Ænonites bittingsae* sp. nov.**

Maxilla I, plate V, fig. 7.

The jaw is elongate, wide anteriorly, and tapers to an acute posterior extremity. The figured specimen measures 0.38 mm. in length. On the inner margin a series of fourteen small, sharp-pointed, conical, backward directed denticles extends nearly the full length of the jaw. The fang is slightly larger than the second denticle. The denticles decrease in size gradually to the posterior end. The anterior margin is rounded to a nearly straight outer margin. A large deep fossa extends nearly the full length of the jaw. One margin of the fossa is extended in to a small shank at the posterior end. The upper surface of the jaw is convex while the under side is flattened.

Ænonites bittingsae is similar to *Æ. dignus* Stauffer (1933) when viewed from the under side. The denticles of the two forms differ in character. Except for the arrangement of the denticles, *Æ. exactus* Eller (1940) resembles *Æ. bittingsae* quite closely. Hinde (1879) described a form *Æ. amplius* from the Clinton of Ontario (probably from the Cataract formation) that resembles *Æ. bittingsae* when viewed from the under side. Some of the figured specimens of *Æ. naviformis* Hinde (1880, 1882) are similar to *Æ. bittingsae*.

Occurrence: The figured specimen is from a small quarry near Millington, Ontario County, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,268.

***Ænonites coggeshalli* sp. nov.**

Maxilla II, plate V, figs. 8-11.

The jaw is elongate and measures from 0.59 mm. to 1.29 mm. in length. A series of fifteen or sixteen sharp-pointed, conical denticles extends the full length of the jaw. The first denticle is larger and more hooked than the other denticles. The next two denticles are usually small and are followed by larger ones which decrease gradually in size to the posterior end. All denticles are pointed in a backward direction. On the outer margin in the anterior part of the jaw a long, narrow flange is present. The flange is thin and usually broken. An irregularly shaped fossa extends the full length of the jaw. The margin of fossa opposite the flange is thickened and rounded.

Ænonites coggeshalli is similar in a general way to *Æ. cadwaladeri* Eller (1941) and, perhaps, *Æ. grandidentatus* Eller (1934).

Occurrence: The figured specimens are from the Rockland near Lindsay, Ontario, and from the Cobourg at Collingwood, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,208; also a paratype, number 25,209. A paratype is also in the collection of Princeton University.

***Ænonites impardentatus* sp. nov.**

Maxilla II, plate V, figs. 12, 13.

The jaw is small, wide anteriorly, and tapers to a blunt posterior end. In length the figured specimen measures 0.38 mm. Along the inner margin a series of sharp-pointed, conical, backward directed denticles of various sizes extends nearly the full length of the jaw. The first denticle is medium in size and is followed by a minute one. The third denticle is the largest and it is followed by three slightly smaller teeth. The remaining denticles are minute. The outer margin on the upper side is notched at the anterior end while the margin on the under side is extended into a small shank-like projection. A narrow fossa occupies the upper side of the jaw. The margins of the fossa are slightly thickened. The upper and lower sides of the jaw are irregularly convex and with flattened areas.

There is a slight resemblance between *Ænonites coggeshalli* and *Æ. imparidentatus*. The two forms differ mostly in the type and arrangement of the denticles and in length.

Occurrence: This form was found in the Cobourg at Port Hope, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,365.

***Ænonites bidwelli* sp. nov.**

Maxilla I, plate V, fig. 14.

The jaw is elongate, narrow at the anterior and posterior ends, and wide at the mid-point. The figured specimen measures 0.59 mm. in length. Along the straight inner margin a series of sixteen small, sharp-pointed, conical denticles extends the full length of the jaw. The fang is only slightly larger than the denticles following. The first three or four denticles, including the fang, point in a forward direction. The remaining denticles decrease in size gradually to the posterior end and are all pointed in a backward direction. A large, deep fossa occupies about two-thirds of the upper side of the jaw. The margins of the fossa are slightly thickened and rounded, except at the posterior end of the inner margin which is wide and flattened.

There is a slight similarity between *Æ. orthodontes* Eller (1939) and *Æ. bidwelli*. *Æ. orthodontes* is wider anteriorly and its denticles do not extend to the posterior end. *Æ. crepitus* Eller (1942) resembles *Æ. bidwelli* quite closely but the fang, denticles, and outer margin do not correspond. Hinde (1879) described three specimens of *Eunicites varians* (Grinnell) from the Cincinnati Group of Ontario and a form *Ænonites amplius* Hinde that have characteristics slightly similar to those of *Æ. bidwelli*. Hinde (1882) figured several specimens of *Ænonites naviformis*, some of which are quite like *Æ. bidwelli*. Searight (1923, fig. 1) illustrated a form, but did not describe it, that resembles *Æ. bidwelli* quite closely. In 1933, Stauffer described three similar forms, *Æ. tacitus*, *Æ. dignus*, and *Æ. inornatus* that slightly resemble *Æ. bidwelli*.

Occurrence: Several specimens of this species were found in the Rockland at Kirkfield and at Napanee in Ontario, and at the intersection of the highways along West Canada Creek, two miles northwest of Poland, New York.

Type: The holotype is in the Carnegie Museum, number 25,301.

Genus PALEÆNONITES, Eller, 1942

Paleœnonites acutus sp. nov.

Maxilla II, plate V, figs. 15, 16.

In outline, the jaw is triangular, wide anteriorly, and the lateral margins taper to an acute posterior extremity. Along the inner margin a series of twelve to sixteen sharp to blunt, conical denticles extends the full length of the jaw. The anterior denticles are small and point forward, while the posterior ones increase gradually in size and point backward. The first denticle or fang is slightly larger and is a continuation of the thickened anterior margin. Specimens measure from 0.56 mm. to 1.13 mm. in length. The anterior margin is slightly incurved and forms a small shank with the gently curved outer margin. On the upper surface a narrow fossa extends from the shank to the posterior end. The margins of the fossa are thickened and well rounded. The under surface of the jaw is convex, while the area between the fossa and the denticles is concave or flattened.

Paleœnonites acutus is similar to *P. latissimus* Eller (1942) except for the width of the jaw, size of the shank, and arrangement of the denticles. *Ænonites kopfi* and *Æ. fornicatus* Eller (1940) resemble *P. acutus* quite closely. They differ from each other in the character and shape of the margins and the fossa and the arrangement of the denticles. *Ænonites radula* Hinde (1882) from the Silurian of Gotland is like *P. acutus* in outline, but the shape and position of the fossa differ.

Occurrence: The species is found in the Rockland at Lindsay, Lakefield, and Kirkfield, and from the Denmark of the Sherman Fall at Copenhagen, New York.

Types. The holotype is in the Carnegie Museum, number 25,201. Paratypes have been deposited in the Royal Ontario Museum of Paleontology and in Princeton University.

Paleœnonites dillae sp. nov.

Maxilla II, plate V, figs. 17-20.

The jaw is triangular in outline and measures from 0.38 mm. to 0.99 mm. in length. Along the straight inner margin a series of from six to eleven conical, sharp-pointed denticles extends only about two-thirds the

length of the jaw. The small, forward-pointing fang is emphasized by a wide and thickened anterior margin present in the upper side of the jaw. Except for the fang, all other denticles point backward and increase in size posteriorly. The inner margin posterior to the denticles is thickened. The anterior margin is rounded near the fang and then incurves deeply, to form a narrow, forward-pointing shank with the straight outer margin. The posterior end is truncate and slightly incurved. On the upper surface a narrow fossa extends nearly the full length of the jaw. The inner margin of the fossa is thickened and rounded. The under surface of the jaw is generally convex, but may be flattened or slightly concave adjacent to the inner margin and posterior to the denticles. The upper margin is concave between the inner margin of the fossa and the denticles.

The general outline of *P. dillae* is somewhat similar to that of *P. accuratus* Eller (1942). They differ in the arrangement of the denticles, characters of the fossa, and in the size of the shank. Except for the character of the denticles and surface features, *Arabellites erectus* Stauffer (1933) resembles *P. dillae* in general shape.

Occurrence: This form was present throughout the Trenton and was found at nearly every locality from Craigeleith, Ontario, to Watertown, New York.

Types: The holotype is in the Carnegie Museum, number 25,333; also a paratype, number 25,335. Paratypes have also been deposited in the Royal Ontario Museum of Paleontology and in Princeton University.

***Paleænonites castigatus* sp. nov.**

Maxilla II, plate V, figs. 21-24.

The jaw is narrowly triangular in shape and measures from 0.43 mm. to 0.52 mm. in length. On the outer margin a series of eight to fourteen conical, sharp-pointed, backward-directed denticles extends nearly to the posterior end. The fang is a little larger than the other anterior denticles. From the anterior to the posterior the denticles increase slightly in size. The wide anterior margin is well rounded adjacent to the fang, but incurves slightly to form a very small shank. The outer margin is slightly curved and the inner margin is nearly straight. The jaw tapers to an acute posterior extremity. On the upper side of the jaw a fossa occupies about half the width of the jaw and extends nearly its full length. The margins of the fossa are thickened and rounded. The underside is convex, while the

narrow area between the fossa and the denticles on the underside is concave.

Except for the width and character of the denticles, *Paleænonites castigatus* is similar to *Paleænonites davisæ*. *Ænonites kopfi* and *Ænonites fornicatus* Eller (1940) resemble *Paleænonites castigatus* except for the width of the jaw and the character of the fossa. *Ænonites radula* Hinde (1882) resembles *Paleænonites castigatus* in a general way but differs in the width of the jaw and the character of the denticles.

Occurrence: *Paleænonites castigatus* was found only in the Rockland, and the figured specimens are from Lindsay, Ontario, and Dexter, New York.

Type: The holotype is in the Carnegie Museum, number 25,234; also a paratype, number 25,235.

***Paleænonites henryi* sp. nov.**

Maxilla II, plate V, figs. 25, 26.

The jaw is subtriangular in outline and measures from 0.43 mm. to 0.52 mm. in length. Along the inner margin a series of from nine to eleven conical, sharp-pointed, backward directed denticles extends nearly to the posterior end. The fang is only slightly larger than the denticles and appears to be a continuation of the rounded anterior margin. Beginning at the anterior, the denticles gradually increase in size to the mid-area and then become smaller to the posterior end. The outer margin is rounded and extended. A narrow fossa extends nearly the full length of the jaw. The margin on the upper side of the fossa is thickened and rounded. The under side of the jaw is highly convex while the upper side is concave.

This form is somewhat similar to *Ænonites alpenaensis* Eller (1938), except for the size and arrangement of the denticles. There is a slight resemblance between *Ænonites radula* Hinde (1882) and *P. henryi*. The outer and anterior margins and the denticles of the two forms differ in their details. There is a general similarity between *P. henryi* and *P. davisæ*.

Occurrence: *Paleænonites henryi* was found in the Rockland at Lindsay and at Lakefield, Ontario. It was especially common at the Lindsay locality.

Types: The holotype is in the Carnegie Museum, number 25,143. Paratypes are in Princeton University and the Royal Ontario Museum of Paleontology.

***Paleœnonites pennatus* sp. nov.**

Maxilla II, plate V, figs. 27, 28.

The jaw is wide and the anterior end is extended. A typical specimen measures 0.54 mm. in length. Along the nearly straight inner margin a series of eleven irregularly shaped denticles extends the full length of the jaw. The fang is long, sharp, and directed forward. The following five or six denticles are small, sharp-pointed, and are both forward and backward directed. The remaining denticles are much larger, blunt, and point in a forward direction. The outer margin is mostly a wide truncate shank formed by a slight incurving of the wide anterior and posterior margins. On the upper surface a wide, deep fossa occupies about one-half of the area. The anterior and inner margins of the fossa are thickened and rounded. The inner margin posterior to the denticles and the inner margin of the fossa converge to form an acute posterior extremity. The under side of the jaw is convex except for the area adjacent to the shank. The upper side is irregularly convex.

Except for some general features, this form is unlike other species of the genus. It is rather rare in the fauna. *Paleœnonites parallelus* Eller (1943) has a similar wide, truncate shank but differs in other characters.

Occurrence: The figured specimen is from the Rockland near Lindsay, Ontario. Other specimens were found at Rockland, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,272.

***Paleœnonites clinatus* sp. nov.**

Maxilla II, plate V, figs. 29-32.

The jaw is large, subtriangular in outline, wide anteriorly and tapers rapidly to an acute posterior end. The figured specimens measure from 0.75 mm. to 1.1 mm. in length. The width of the jaws, although the outer margins are broken, measure from 0.71 mm. to 0.75 mm. Other specimens are as long as 1.6 mm. Along the inclined or curved inner margin a series of about nine to twelve blunt, conical denticles extends the full length of the jaw. The first three denticles are directed backwards while the remaining ones are perpendicular to the long axis or length of the jaw. The denticles decrease in size uniformly from the large anterior teeth to the small ones at the posterior end. The outer margin on the upper side is irregular and usually broken. It forms a large shank

with the curved anterior margin. A long narrow fossa occupies the anterior end of the jaw and extends to the posterior extremity. Part of the anterior margin and one of the lateral margins of the fossa is thickened and rounded. The under side of the jaw is concave while the upper side is convex.

There is a slight resemblance between *Paleænonites clinatus* and *Enonites fornicatus* Eller (1940) and *Paleænonites latissimus* Eller (1942). The species differ in the shape of the fossa and the position of the denticles. *Paleænonites davisæ*, described in this paper, is similar to *P. clinatus* except for the size and position of the denticles. The fossa of both forms extends well to the anterior of the jaw.

Occurrence: The figured specimens are from the Rockland at Kirkfield, Ontario, and Middle Trenton at Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,414; also paratypes, numbers 25,463-4.

***Paleænonites frickei* sp. nov.**

Maxilla II, plate V, figs. 33, 34.

The jaw is small, irregularly rectangular in outline, and the figured specimen measures 0.24 mm. in length. A series of twelve small, blunt denticles extends nearly to the posterior end. The first denticle or fang is slightly larger and points in a forward direction. The second and often the third denticle are directed forward, but the remaining ones are nearly perpendicular to the straight inner margin. They do not noticeably decrease in size to the posterior end. The anterior of the jaw is sharply incurved from the fang and extends into a heavy shank. The outer margin is straight, while the posterior margin is broadly rounded. The under side is irregularly convex, except for a triangular area which is concave. A long, narrow fossa occupies most of the upper side of the jaw. The margin of the fossa, except that which makes up part of the shank, is thickened and rounded. The upper side is flattened or slightly concave between the thickened margin and the denticles.

Although this species conforms well with this genus it does not resemble any other species closely enough to warrant comparisons.

Occurrence: *P. frickei* was found in the Upper Cobourg at Collingwood, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,266.

***Paleœnonites comptus* sp. nov.**

Maxilla II, plate V, figs. 35, 36.

The jaw is rectangular in outline, nearly as wide posteriorly as anteriorly, and the figured specimens measure 0.54 mm. in length. Slightly adjacent to the inner margin a series of twelve small, blunt denticles extends about two-thirds the length of the jaw. The fang is a little larger than the other anterior denticles and is strengthened by a thickened anterior margin developed on the upper side of the jaw. The anterior denticles point forward, while the posterior ones point backwards and increase in size. Following the last denticle, a thick, rounded ridge is present which curves around the posterior end and is present for a short distance adjacent to the outer margin. The anterior margin is notched by a deep crescent-shaped bight, which forms a narrow, curved, forward directed shank with the slightly curved outer margin. The posterior margin is widely truncate. On the upper side of the jaw a wide fossa is present. The margin of the fossa is thickened, especially at the posterior end. The under side of the jaw is convex except at the posterior end adjacent to the denticles and the ridge. The upper side is mostly convex except for the area near the fang.

There is a general resemblance between *P. comptus* and *P. dillae*. The two species differ in the shape of the fossa and the character of the posterior end. *Paleœnonites accuratus* Eller (1942) has a ridge posterior to the denticles similar to *P. comptus*. The two species, however, differ in several other respects.

Occurrence: Scolecodonts are very common at a small quarry in the west end of Collingwood, Ontario, where what is probably Upper Cobourg limestone is exposed.

Type: The holotype is in the Carnegie Museum, number 25,176.

***Paleœnonites davisae* sp. nov.**

Maxilla II, plate V, figs. 37, 38.

The jaw is triangular in outline and the outer and inner margins form an acute posterior extremity. All specimens measured about 0.52 mm. in length. On the inner margin a series of ten or eleven small, conical denticles extends and decreases in size to the posterior end. The fang is considerably larger than the rest of the denticles and seems to be a con-

tinuation of the outer and anterior margins. The outer margin is straight and forms a broad shank with the anterior margin. A large fossa occupies all the upper side of the jaw. It is surrounded by a thickened margin. The under side of the jaw is concave but the opposite side is convex, especially near the rounded margin.

In a general way, *Paleænonites latissimus* Eller (1942) is similar to *P. davisæ*. *Enonites alpenaensis* Eller (1938) resembles *P. davisæ* except for the shape of the fossa and the character of the denticles. *Enonites radula* Hinde (1882), from the Silurian of Gotland, resembles *P. davisæ* in a general way but differs in the shape of the anterior margin and fossa.

Occurrence: The figured specimen is from the Rockland about two miles north of Lindsay, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,246. Paratypes have been sent to Princeton University and the Royal Ontario Museum of Paleontology.

***Paleænonites circumscriptus* sp. nov.**

Maxilla II, plate V, figs. 39-42.

The jaw is narrow and tapers to an acute, elongate anterior end. A typical specimen measures 0.54 mm. in length. Along the straight inner margin a series of twelve conical, sharp to blunt denticles extends for about three-quarters the length of the jaw. The denticles on the anterior half of the jaw point forward, while those on the posterior half point backward. The denticles increase slightly in size posteriorly. The fang is a little larger than the anterior denticles and is emphasized by a ridge along the anterior margin on the upper side of the jaw. The anterior and outer margins are nearly straight but form a short, blunt shank. The posterior end is narrow and is notched by small indentations. A shallow fossa occupies part of the upper surface of the jaw. The margins of the fossa, especially the inner one, are thickened and rounded. The under surface is irregularly convex, while the upper surface is concave between the margin of the fossa and the denticles.

Paleænonites circumscriptus is more narrow and the anterior is more elongate than other species of the genus.

Occurrence: *P. circumscriptus* was collected from the Rockland at the escarpment about two miles north of Lindsay, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,269.

Paleœnonites accuratus ? Eller

Maxilla II.

Paleœnonites accuratus Eller, 1942, Annals, Carnegie Museum, vol. xxix, p. 252, pl. 2, figs. 17, 18.

P. accuratus ? Eller was found in large numbers in the Meaford formation, Upper Ordovician, at Streetsville, Ontario. It seems to be widely distributed in the Trenton. Specimens were found near Lindsay, Kirkfield and Lakefield in Ontario, and south of Watertown, New York. The Trenton form lacks the narrow ridge that extends from the last denticle across the posterior and along the outer margin. The absence of the surface structure may constitute a specific difference.

Genus EUNICITES, Ehlers, 1868

Eunicites tolmachoffi sp. nov.

Maxilla III or IV, plate VI, figs. 1-7.

The jaw is small, subrectangular in outline and measures from 0.13 mm. to 0.35 mm. in length and from 0.18 mm. to 0.67 mm. in width. A series of three or four large, conical, sharp-pointed denticles extends the full length of the inner margin. The first denticle is slightly larger and the denticles decrease in size gradually to the posterior end. The outer margin of the under side is extended inward to form a heavy, curved, sharp-pointed shank. Probably the shank acted also in the capacity of a denticle. In position it is parallel to the denticles but not in the same plane. A large fossa occupies the upper side of the jaw and extends slightly into the shank. The margins of the fossa are thin and usually broken. The upper side adjacent to the denticles and shank is concave. The under side is convex.

Jaws of this type are common in most faunas but differ widely in individual form. If enough specimens were available perhaps this species might be split into several species. *Eunicites mutabilis* Eller (1934) and *E. divergens* Eller (1938) are similar in a general way to *E. tolmachoffi*.

Occurrence: This species is common in the Trenton and was found from Collingwood, Ontario, to Lowville, New York. The figured specimen comes from Lindsay, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,261; also a paratype, number 25,547. Paratypes have been deposited in the Royal Ontario Museum of Paleontology and at Princeton University.

Eunicites geisacanthus sp. nov.

Maxilla IV or V, plate VI, figs. 8-10.

The jaw consists of a single small, thick, subtriangular denticle which tapers abruptly from a wide base to an acute anterior end. The figured specimen measures 0.43 mm. in length. The jaw is quite angular and two definite ridges are formed at the midpoint and extend to the anterior end. Along these two ridges are a series of minute denticles or hair-like serrations. They are pointed in a forward direction. The upper side of the jaw is occupied by a large fossa. The margins of the fossa are slightly thickened and rounded. The surfaces of the jaw are irregularly concave and convex.

Several species in this fauna have small hair-like spines along a single or double denticle. In outline *E. geisacanthus* is very much like *E. whiteae*. *E. geisacanthus* differs however in its angularity, width of fossa, and the presence of the minute spine-like teeth along the borders.

Occurrence: The figured specimen is from the St. Maurice Quarry north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,537.

Eunicites whiteae sp. nov.

Maxilla V ?, plate VI, figs. 11, 12.

The jaw is a single sharp-pointed, subtriangular denticle or fang measuring 0.35 mm. in length and 0.54 mm. in width. A smaller figured specimen measures 0.18 mm. in length and 0.38 mm. in width. The anterior margin is wide and slightly curved while the posterior end is acute. The inner and outer margins are curved. A narrow fossa occupies the complete outer margin.

Eunicites whiteae is very similar to *E. denticulatus* Eller (1942). They differ from each other in the width of the jaw and the shape of the fossa. There is a slight similarity between *Arabellites* (?) *conus* Eller (1938) and *E. whiteae*.

Occurrence: The figured specimens came from the Rockland in the escarpment four miles north of Lindsay, Ontario, and from the Middle Trenton near Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,345; also a paratype, number 25,536.

***Eunicites compressus* sp. nov.**

Maxilla IV or V, plate VI, figs. 13, 14.

The jaw is small, thin, and wedge shaped. The figured specimens measure 0.33 mm. and 0.27 mm. in length and 0.43 mm. and 0.54 mm. in width respectively. The jaw has a single blunt denticle with a very small base. The outer margin is slightly incurved. On the upper side, a wide, shallow fossa occupies the full length of the jaw. The margins of the fossa are thickened and rounded, especially at the posterior part. The upper side of the jaw is convex while the under side is concave or flattened. The concavity of the under side causes the shallowness of the fossa and the compressed appearance of the jaw.

Specimens of this type are often common in a fauna, but usually they seem to be incomplete and the writer has hesitated to describe them. The margins of *Eunicites compressus* appear to be complete; thus a description is offered. *Arabellites* ? *conus* Eller (1938), *E. denticulatus* Eller (1942), and *E. whiteae* are similar to *E. compressus* in a general way.

Occurrence: The figured specimens are from the Rockland at Lakefield, Ontario, and from the Middle Trenton north of Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,380; also a paratype, number 25,533.

***Eunicites barbaricus* sp. nov.**

Maxilla IV or V, plate VI, figs. 15, 16.

The jaw is a single, elongate, angular, cone-like fang which tapers to a sharp-pointed anterior end. The width at the posterior end, which may be broken, is 0.16 mm.; the length is 0.43 mm. The lateral sides are nearly straight to just beyond the mid-area where a slight backward directed curve is present. Extending along each side is a thin, narrow ridge or flange which bears a series of minute, hair-like crenulations or teeth. They extend the full length of the jaw. In a cross section the jaw is flattened and angular, especially at the anterior end. A large fossa occupies the posterior end of the jaw.

Eunicites acis, described in this paper, is also a single denticle or fang with minute thorn-like crenulations. It is, however, much smaller in size and rounder in cross section than *Eunicites barbaricus*.

Occurrence: The figured specimens are from the Rockland at Kirkfield, Ontario, and from the St. Maurice Quarry at Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,432; also a paratype, number 25,605.

***Eunicites toddi* sp. nov.**

Maxilla III or IV, plate VI, fig. 17.

The jaw is subtriangular in outline. Two short, heavy, sharp pointed denticles are present on the inner margin. On the anterior and posterior margins a series of minute serrations are present. A large fossa occupies the length of the jaw. Due to broken margins the true shape of the fossa is not discernible. The upper and under sides of the jaw are irregularly convex.

Like *Eunicites acis*, this form has the hair-like spines on the margins. It will be retained in the genus *Eunicites* for the present. Jaws of this strange type have never been observed among fossil species and to the best of the writer's knowledge they do not occur among recent forms.

Occurrence: *E. toddi* was found in the Rockland and the figured specimen is from near Lindsay, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,232. A paratype has been deposited in the Royal Ontario Museum of Paleontology.

***Eunicites sweadneri* sp. nov.**

Maxilla I, plate VI, figs. 20, 21.

The jaw or forceps is long, thick, angular, and wide posteriorly, and pointed anteriorly. When viewed from the side it may be seen that the jaw is curved at the anterior third nearly in a right angle. Specimens measure from 1.02 mm. to 1.08 mm. in length. A large, round, deep fossa is present in the posterior third of the jaw. The margins of the fossa are slightly thickened and rounded. Most of the jaw is irregularly convex except for the areas adjacent to the fossa.

The side view, fig. 21, probably illustrates the position of the jaw in the annelid. Many recent forms have jaws of this type. This species differs only slightly from other species of *Eunicites*. The shape and position of the fossa is unlike other forms.

Occurrence: *E. sweadneri* was found in the Cobourg at Collingwood and at Cobourg, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,325; and a paratype has been deposited in the Royal Ontario Museum of Paleontology.

***Eunicites kirkfieldensis* sp. nov.**

Maxilla IV, plate VI, fig. 22.

The jaw is sub-oval in outline and the width is more than twice the length. The figured specimen measures 0.83 mm. in width and 0.36 mm. in length. Along the inner margin, and extending part way along the posterior margin, is a series of long, narrow, conical, sharp-pointed denticles. The first one is small and they increase in size to the fourth denticle which is the largest. They then decrease in size to minute thorn-like teeth at the posterior end. A fossa is present on the upper side of the jaw. The margins of the fossa are irregular and broken. The under side of the jaw is convex while the upper side is generally concave especially adjacent to the denticles.

This species does not resemble any other described form very closely. *Eunicites acus*, described in this paper, and *E. mutabilis* Eller (1934), figure 6, bear the same type of long, thin, sharp-pointed denticles.

Occurrence: The figured specimen is from the Rockland at Kirkfield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,431.

***Eunicites twomeyi* sp. nov.**

Maxilla I ?, plate VI, fig. 23.

The jaw is wide, short, and measures 1.13 mm. in length and 0.54 mm. in width. The posterior end of the jaw is very wide and tapers rapidly to a narrow anterior extremity. The outer margin is nearly straight while the inner margin curves abruptly from the posterior end. The upper surface is flattened while the under surface is convex. A number of irregular elongated nodes are present on the surface. The entire posterior end of the jaw is occupied by a large fossa. The margins of the fossa are thin and usually broken.

This form is not similar to any other species of the genus. The node-like projections have not been noticed before on the jaws of any fossil Polychaeta.

Occurrence: Only a single specimen of this form was found. It is from the Rockland near Lindsay, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,271.

Eunicites acus sp. nov.

Maxilla IV, plate VI, fig. 24.

The jaw is small, subrectangular in outline and measures 0.27 mm. in length and 0.52 mm. in width. A series of six long, conical, narrow, very sharply-pointed denticles extends the full length of the inner margin. The first denticle is small and the others increase in size uniformly to the posterior end. The anterior margin is straight while the posterior margin is irregular. A large irregular fossa extends the full length of the jaw. The margins of the fossa are thin and the under one is usually broken. The upper side is concave while the under side is convex and is about twice the size of the upper.

Eunicites acus is similar to *E. mutabilis* Eller (1934), fig. 6, except for the size and arrangement of the denticles.

Occurrence: At a small quarry on lot 13, concession A, Mara Township near Gamebridge, Ontario County, Ontario, what is probably the Rockland limestone is exposed. The figured specimen comes from this locality.

Type: The holotype is in the Carnegie Museum, number 25,258.

Eunicites colossus sp. nov.

Maxilla IV or V, plate VI, fig. 25.

The jaw consists of a very large plate or shank with a large, conical, sharp-pointed denticle at the anterior end. The denticle is at right angles to the lateral margins. The figured specimen measures 0.99 mm. in length and 0.67 mm. in width. A fossa extends the full length of the jaw and is deep at the anterior end but very shallow posteriorly. The margins of the fossa are wide and thickened. Except for the denticle the underside of the jaw is slightly concave.

Modern polychaete jaws of this type, represented by the fourth or fifth maxilla, are common. If *Eunicites colossus* is a fifth maxilla, then the component jaws of the complete jaw apparatus would probably have to be extremely large in size. Two other species, *E. cavus* and *E. ansatus*, are similar to *E. colossus* either in the shape of the denticle, the position and shape of the fossa, or in the size and shape of the plate or shank. Hinde, 1882, described the species *Arabellites uncinatus* from the Silurian of Gotland in a variety of forms that resemble *Eunicites colossus* very closely.

Occurrence: The figured specimen is from the Middle Trenton at the St. Maurice quarry, north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,549.

***Eunicites acis* sp. nov.**

Maxilla V, plate VI, fig. 26.

The jaw is a small, slightly flattened cone. The figured specimen measures 0.13 mm. in length and 0.21 mm. in width. The jaw is wide at the base and tapers rapidly to a sharp-pointed anterior end. Along the sides of the jaw a series of minute, hair-like teeth are present. They are directed forward and extend the full length of the jaw. A wide fossa occupies the complete base of the jaw. The margins of the fossa are rounded and thickened.

Serrations on a denticle or fang have not been observed in fossil polychaete jaws before. The described specimen seems to be complete and unbroken at the fossa. This species is placed in the genus *Eunicites* until further material is available for study.

Occurrence: Just east of Dunsford, Victoria County, Ontario, a shallow limestone, probably Rockford in age, crops out along the highway near the railroad crossing. The figured specimen is from this locality.

Type: The holotype is in the Carnegie Museum, number 25,260.

***Eunicites aculeus* sp. nov.**

Maxilla V?, plate VI, figs. 27, 28.

The jaw is small and rectangular in shape with a single long, thin, slightly curved fang or denticle. The figured specimen measures 0.54 mm. in length. A small, round fossa is present at the base of the fang. The posterior end of the jaw is wide and obliquely truncate. The upper and under surfaces are flattened.

In recent Polychaeta, fangs of this type are common but as fossils they are rather rare. *Eunicites aculeus* is not very similar to any other species.

Occurrence: This species was found in the Denmark member of the Sherman Fall at Trenton Falls, New York.

Type: The holotype is in the Carnegie Museum, number 25,344.

***Eunicites conjectus* sp. nov.**

Maxilla III, plate VI, fig. 29.

The jaw is rectangular in outline and the figured specimen measures 0.62 mm. in length. Along the inner margin a series of four short, blunt

denticles extends the full length of the jaw. The denticles are nearly equal in size and are perpendicular to the length of the jaw. A deep groove between each denticle which extends nearly to the outer margin gives them the impression of being long as well as wide. A large deep fossa occupies the upper side of the jaw. The margins of the fossa are mostly broken.

Jaws of this kind are usually present in collections of scolecodonts. The shortness of the denticles and the extension as a groove of the small spaces in between each denticle, warrant description of this form.

Occurrence: The figured specimen is from the Rockland at Kirkfield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,558.

***Eunicites planoconvexus* sp. nov.**

Maxilla IV, plate VI, figs. 30, 31.

The jaw is irregular in outline and angular in form. The width of the jaw is 0.4 mm. and the length 0.29 mm. Two long, narrow, sharp-pointed denticles are present on the underside of the jaw. The anterior, posterior, and lateral margins are nearly straight and form angles with each other. A deep fossa occupies the entire upper surface of the jaw. The surfaces formed by the denticles on the under side are concave or flattened.

At first it was thought that jaws of this type were fragments but the completeness of the anterior and posterior margins eliminates that possibility. *E. planoconvexus* resembles other species of this genus only in a general way. Most forms of this type have three or more denticles.

Occurrence: The figured specimen is from the Rockland at Paquette Rapids, Ottawa River, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,604.

***Eunicites plackae* sp. nov.**

Maxilla I or V, plate VI, fig. 32.

The fang or jaw is regularly curved from the anterior to the posterior end. The width of the jaw is narrow and uniform in size. It tapers gently at the anterior to an acute end. The figured specimen measures 0.64 mm. in length. An irregular fossa, parallel to the long axis of the jaw, is present at the posterior end. The margins of the fossa are thickened, slightly flattened, and extended as small flanges at the anterior. On the inner surface there is a small groove which extends to the margin of the fossa between the flanges. In the posterior part of the jaw a slight ribbing effect is discernible.

This form is similar in its general character to several other species. It differs in the shape of the fossa. The presence of the minute ornamentation at the posterior end has not been observed in other forms.

Occurrence: About four miles north of Peterborough, Ontario, near the highway is a small quarry of what is probably Rockland limestone. The figured specimen was found at this quarry.

Type: The holotype is in the Carnegie Museum, number 25,247.

***Eunicites cavus* sp. nov.**

Maxilla V, plate VI, figs. 33, 34.

The jaw is a single denticle or fang extending from an angular base. It measures from 0.35 mm. to 0.81 mm. in length and from 0.38 mm. to 1.08 mm. in width. The anterior and outer margins are nearly straight and are at right angles to each other. The fang is conical, sharp-pointed, and is an inner termination of the anterior margin. A small blunt or sharp-pointed shank is present at the opposite end of the outer margin. Most of the upper surface is occupied by a fossa which extends halfway along the anterior edge of the fang.

This form is common in the fauna but does not resemble very closely any other species. *Arabellites uncinatus* Hinde (1882) is a single denticle with an extended plate slightly similar to *Eunicites cavus*.

Occurrence: The species seems to be limited to the Rockland and is especially common at Kirkfield, Ontario. Several large specimens were found in the Middle Trenton at St. Maurice quarry, north of Three Rivers, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,291; also a paratype, number 25,548. Paratypes are in the collections of the Royal Ontario Museum of Paleontology and Princeton University.

***Eunicites ansatus* sp. nov.**

Maxilla V, plate VI, figs. 35, 36.

The jaw is composed of a single denticle or fang with a wide flattened base or shank. The figured specimen measures 0.54 mm. in width. The fang is conical and very acute, but widens rapidly to the base. A large shallow fossa occupies nearly half of the upper side of the jaw. The margins of the fossa are wide and thickened, especially at the anterior end. A large flattened shank extends posteriorly from the jaw. The upper surface of the jaw is convex except the shank which has a slight crease or concave

area beginning on the right margin and running lengthwise. Except for the fossa the under side is convex.

Eunicites ansatus is similar to *E. cavus* except for the width of the shank and character of the fossa.

Occurrence: The figured specimen is from the Middle Trenton, north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,543.

Genus UNGULITES, Stauffer, 1933

***Ungulites longidentatus* sp. nov.**

Maxilla III or IV, plate VII, fig. 1.

The jaw is elongate and large. The figured specimen measures more than 0.78 mm. in length. A large fang and three small denticles are present on the inner margin. The fang measures 0.43 mm. in length. It is thin, conical, and tapers to a needle-like point. The remaining denticles are conical and sharp-pointed, and decrease in size posteriorly. All the denticles are pointed in a direction nearly perpendicular to the margins. A fossa occupies all of the side of the jaw. The margins of the fossa are thin and broken. The under side or area adjacent to the denticles is slightly concave.

Ungulites longidentatus is slightly similar to *U. sumnerae*. The two species differ in the shape and number of the denticles and the surface contours. *U. bicuspidatus* Stauffer (1933) resembles *U. longidentatus* only in a general way.

Occurrence: The figured specimen is from the Rockland, three miles north of Lindsay, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,376.

***Ungulites sumnerae* sp. nov.**

Maxilla III or IV, plate VII, figs. 2, 3.

The jaw is large and cone-shaped in form. Specimens measure from 0.78 mm. to 1.16 mm. in width and from 0.32 mm. to 0.49 mm. in length. The inner margin bears a large fang and two conical denticles. The fang is long, sharp-pointed, and conical or slightly flattened. There is no uniformity of direction in which the denticles or fangs point. A large round or angular fossa occupies the complete side of the jaw. The margins of the fossa are slightly thickened but in most specimens are broken. The upper side of the jaw is convex while the under side is usually flattened.

The orientation of the jaw is questionable but probably the denticles extended slightly forward. There is only a slight similarity between *U. bicuspidatus* Stauffer (1933) and *U. sumnerae*.

Occurrence: This species was found only in the Rockland and the figured specimens are from near Lindsay, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,205; also a paratype, number 25,206. A paratype is in the Royal Ontario Museum of Paleontology.

***Ungulites bifurcus* sp. nov.**

Maxilla III or IV, plate VII, fig. 4.

The jaw is wedge-shaped and measures 0.27 mm. in length and about 0.75 mm. in width. A long, angular, sharp-pointed fang occupies the inner margin. At the base of the fang on the posterior margin, a small, conical, sharp-pointed denticle is present. It appears to be part of the fang. About half of the upper side of the jaw is occupied by a wide, deep fossa. The outer margin of the fossa is broken.

Stauffer (1933) described a species, *U. bicuspidatus* Stauffer that resembles *U. bifurcus* closely except for the length of the jaw and the shape of the denticles.

Occurrence: The figured specimen is from the Rockland at Lakefield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,379.

***Ungulites confertus* sp. nov.**

Maxilla III, plate VI, figs. 18, 19.

The jaw is twice as wide as it is long. The figured specimen measures about 0.33 mm. in length. A series of five conical, sharp-pointed denticles occupies the inner margin. The first denticle is small and situated at the base of the large second denticle or fang. The two denticles are pressed close together. The remainder of the denticles are small and decrease in size to the posterior end. A large fossa occupies half of the upper side of the jaw. The margins of the fossa are thin. The under and upper surfaces of the jaw are irregularly convex.

Ungulites confertus is similar to *U. sumnerae* and *U. longidentatus* in general shape and in the character of the denticles. The presence of a small denticle anterior to the fang and the shortness of the second denticle or fang are specific differences.

Occurrence: The figured specimen is from St. Maurice Quarry, north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,542.

Genus NEREIDAVUS, Grinnell, 1877

Nereidavus avinoffi sp. nov.

Maxilla I, plate VII, figs. 5, 6.

The jaw is elongate, narrow anteriorly, and wide at the middle and the posterior end. In length, the jaws vary from 0.32 mm. to 1.24 mm.; the figured specimen measures 1.05 mm. Along the inner margin, a series of from eighteen to twenty-two sharp-pointed, conical denticles extends to the posterior end. The fang is long, thin, and pointed, and it is out of alignment with other denticles. The next three or more denticles are long and narrow and may be pointed in a forward direction. Following these are some small denticles that gradually became larger to a point at about the posterior third of the jaw. The denticles then decrease in size rapidly to the posterior end. A wide, angular flange with nearly straight sides is present on the inner margin at the posterior third of the jaw. The outer margin is wide and gently rounded. The posterior end is wide and obliquely truncate. A large fossa occupies about one-half the upper surface of the jaw. The margins of the fossa are thickened and well rounded. The upper surface is convex while the lower is flattened and irregularly concave and convex.

The width of the mid-area, the large size of the fossa, and the wide flange are not particularly characteristic of the genus. The species, however, does not fit in any other group very well. If *Nereidavus avinoffi* is compared with *N. procurvus* Eller (1942), certain similar characteristics may be observed. A like resemblance may be also noted in *N. alatus*.

Occurrence: The type specimen is from the Rockland near Lindsay, Ontario. The form occurs commonly throughout the Trenton from Craigleith, Ontario, to Rodman, New York.

Types: The holotype is in the Carnegie Museum, number 25,171. Paratypes have been deposited in Princeton University and in the Royal Ontario Museum of Paleontology.

Nereidavus artatus sp. nov.

Maxilla I, plate VII, figs. 7, 8.

The jaw is long, narrow, and measures 0.51 mm. in length. On the inner margin a series of minute, sharp-pointed denticles, nearly perpen-

dicular to the margin, extends for about two-thirds the length of the jaw. The large, conical, sharp-pointed fang is slightly out of alignment with the denticles. At each end of the series of denticles, there is a suggestion on the margin of additional dentation. The outer margin curves irregularly but, in general, is nearly parallel to the inner margin. The posterior end is rounded and notched. A narrow fossa occupies the posterior third of the jaw. The margins of the fossa are thickened and well rounded. The upper side of the jaw is convex except at the posterior end where there is a concave area adjacent to the fossa. The under side is flattened except for a convex area at the posterior end.

Nereidavus artatus is similar to a number of closely related species extending from the Ordovician to the Upper Devonian. The Silurian form, *N. invisibilis* Eller (1940) resembles it in a general way. *N. harbisonae* Eller (1941) and *N. ontarioensis* Stauffer (1939) from the Middle Devonian have the same general characteristics but differ in details. The Upper Devonian form *N. perlongus* Eller (1934) is similar to *N. artatus* except for the denticles. Zebra (1935) described two species, *Arabellites kettneri* and *A. angustidens*, which are probably related to *Nereidavus artatus*, although the denticles in Zebra's species are not discernible. A third species, *Arabellites perneri* Zebra, fig. 1, may be related to this group and also to the other two beforementioned species described by Zebra. *Cenonites aspersus* Hinde (1880) is another example in which the denticles were not discernible. This form resembles Zebra's specimen and is also similar to *N. artatus*.

Occurrence: The type specimen is from the Denmark, Sherman Fall, Copenhagen, New York.

Type: The holotype is in the Carnegie Museum, number 25,346.

***Nereidavus alatus* sp. nov.**

Maxilla I, plate VII, figs. 9-11.

The jaw is elongate, narrow anteriorly and wide posteriorly. The figured specimen measures 1.70 mm. in length. A series of fourteen sharp, conical denticles extends nearly to the posterior end. The fang is narrow, long, sharp, and slightly hooked. The first three or four denticles are irregular in size and point slightly forward. The next three or four denticles are large. Following these the denticles become gradually smaller. Except for the anterior ones all the denticles are directed backward. The outer and inner margins widen in the posterior third of the jaw and form wide

flanges or wings. The posterior end is wide and truncate. A narrow fossa occupies the posterior third of the jaw. The margins of the fossa are not thickened except at the anterior end. The under side is convex except for a groove in the posterior end.

Nereidavus procurvus Eller (1942) is similar in a general way to *N. alatus*. The denticles of the two forms are quite different. A slight relationship may be noted between *N. perlongus* Eller (1934) and *N. alatus*.

Occurrence: The type specimens are from the Cobourg at Collingwood and the Rockland at Lakefield, Ontario. The species is quite common and was found from Craigleith, Ontario, to Rodman, New York.

Types: The holotype is in the Carnegie Museum, number 25,165, also a paratype, number 25,166; and other paratypes have been deposited in Princeton University and the Royal Ontario Museum of Paleontology.

***Nereidavus angulosus* sp. nov.**

Maxilla I, plate VII, figs. 12-16.

The jaw is long and narrow and measures from 0.59 mm. to 0.78 mm. in length. Along the straight inner margin there is a series of about twenty denticles of three different types. Following a short, heavy, well-hooked fang is a group of ten or eleven sharp, conical denticles which are directed backward. The next five or six denticles are large and blunt. In some specimens these groups of denticles are not well developed. The last six or seven denticles are small and blunt and extend nearly to the end of the jaw. Often part of the denticles, especially in the mid-area, will be oblique to the surface of the jaw. The margins of the jaw are nearly parallel and the outer one is irregularly curved. At the posterior end of the outer margin an angular-shaped bight is present. The posterior end of the jaw is acute. A deep, angular-shaped fossa is present in the posterior half, including the small shank formed by the indentation on the outer margin. The margin of the fossa is thickened and rounded. Both upper and lower sides of the jaw are convex, but often irregularly so.

Jaws of this type have been found from the Ordovician to the Devonian. They are all left jaws. Usually it is not possible to decide which left and right jaws go together when they are not found in an articulated position. Forms of this type are quite distinct from other species of the genus. It is probable that a new genus should be erected to include these species. Forms that are similar to *Nereidavus angulosus* and to each other are as follows: *N. hamus* Eller (1942), *N. invisibilis* Eller (1940), *N. perlongus*

Eller (1934), and *N. harbisonae* Eller (1941). *Nereidavus ontarioensis* Stauffer (1939) and *Ænonites aspersus* Hinde (1882) are similar to *N. angulosus* in a general way. Zebra (1935) described three species, *Arabellites perneri*, *A. kettneri*, and *A. angustidens* that are very similar to each other and which resemble *N. angulosus*. Although the posterior ends are shown but only one side of the species is illustrated, exact comparison cannot be made.

Occurrence: *N. angulosus* is from the Rockland. The figured specimens were found at Lakefield and near Lindsay, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,223, also a paratype, number 25,224.

***Nereidavus procurvus* ? Eller**

Maxilla I.

Nereidavus procurvus Eller, 1942, Annals, Carnegie Museum, vol. xxix, pp. 247, 248, pl. 1, figs. 22, 23.

A large number of specimens, in not too good a state of preservation, were found at various Trenton localities. These may be referred to the form found at Streetsville, Ontario, in the Meaford formation, Upper Ordovician. The Trenton specimens differ in a number of details. The second denticle is not so large, the fang is more hooked, and there are more denticles than in those from the Meaford formation.

MARLENEITES, new genus

The jaw is narrow, sub-oval in outline, and usually short although it may be elongate. A series of denticles extends the full length of the jaw or nearly to the posterior end. The denticles are often quite uniform in size but usually they are larger at the anterior end and decrease in size to the posterior extremity. The anterior end is usually broadly rounded and the posterior end may be blunt or acute. The under side, bearing the denticles, may be straight, arched, or curved. In most forms, the under side is convex but it may be flattened or slightly concave near the edges and at the anterior end. A fossa occupies the complete upper side. The margins of the fossa are thickened and rounded.

Genotype, *Ænonites marginatus* Eller, American Midland Naturalist, vol. 32, p. 700, pl. II, figs. 11-14 (1944).

There is a similarity between the forms included in the genera *Marleneites* and *Staurocephalites*. In *Staurocephalites*, the first denticle seems to be a continuation of the anterior and an inner margin. In both genera, the

fossa occupies the complete upper side but the margin of the fossa of *Marleneites* is thickened and rounded while the margin in *Staurocephalites* is usually thin and broken. Formerly, the writer had placed jaws of this type in the genus *Enonites* but they do not correspond well with Hinde's description, "Jaws with a more or less curved anterior hook followed by a series of smaller teeth, similar in character to those of the existing genus *Enone*." The genotype, *Marleneites marginatus* (Eller), *Enonites excavatus* Eller (1941), and four new species, *Marleneites aureus*, *M. arduus*, *M. farrari* and *M. millerae*, described in this paper, are included in the new genus.

***Marleneites millerae* sp. nov.**

Maxilla II, plate VII, figs. 17-19.

The jaw is elongate, wider at the mid-area and measures 0.38 mm. in length. A series of thirteen, nearly uniform, sharply pointed, conical denticles extends along the curved inner margin to the posterior extremity. At the mid-point, the denticles are slightly larger. The anterior and posterior ends are acute. When the jaw is viewed from the side, the margin bearing the denticles is gently arched. The outer margins are curved and slightly thickened. A large fossa, shallow along one side, extends the complete length of the jaw.

Staurocephalites antiquus Stauffer (1933), fig. 37, resembles *Marleneites millerae* when viewed from the side. Stauffer's specimen has nearly twice as many denticles and the anterior and posterior ends are more truncate.

Occurrence: The figured specimen is from the Rockland, four miles north of Peterborough, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,161.

***Marleneites arduus* sp. nov.**

Maxilla II, plate VII, figs. 20-23.

The jaw is small, not narrow, and tapers gently to rounded ends. Specimens range in length from 0.35 mm. to 0.48 mm. On the convex lower surface a series of eleven or twelve sharp, conical, backward directed denticles extends the full length of the jaw. The denticles are usually quite uniform in size but may be slightly larger at the anterior end or at the mid-area. The inner margins are parallel and slightly rounded. A large, deep fossa occupies the upper side of the jaw. The margin of the fossa is thickened and rounded.

Marleneites arduus is very similar to *M. marginatus* (Eller) in its general characteristics. The two species differ in the shape of the outer margins, the concavity and convexity of the lower side, and the thickness of the margins.

Occurrence: The figured specimens are from the Rockland near Lindsay, and from the Cobourg at Collingwood, Ontario.

Types: The holotype is in the Carnegie Museum, number 25,153; also a paratype, number 25,154.

***Marleneites aureus* sp. nov.**

Maxilla II, plate VII, fig. 25.

The jaw is long and narrow and the figured specimen measures 1.02 mm. in length. On the inner margin, a series of thirteen sharp-pointed, widely conical denticles extends the full length of the jaw. The first six denticles are large and widely spaced. The remaining ones decrease in size rapidly to the posterior end. The anterior margin is rounded. Nearly parallel lateral margins terminate in an obtuse posterior extremity. A large wide fossa occupies the complete upper side of the jaw. The margins of the fossa are slightly thickened and rounded. The under side of the jaw is irregularly concave adjacent to the row of denticles.

M. marginatus (Eller) 1944, is similar to *M. aureus* in general shape. They differ in length, thickness of the margins, and the character and distribution of the denticles. There is a slight resemblance between *M. arduus* and *M. aureus*. The length of the jaw and type of denticles is not the same for the two forms.

Occurrence: The type specimen was found in the Selby member of the Rockland at Lowville, New York.

Type: The holotype is in the Carnegie Museum, number 25,162.

***Marleneites farrari* sp. nov.**

Maxilla II, plate VII, fig. 27.

The jaw is elongate and sub-oval in outline. Both the anterior and posterior margins are broadly rounded. A series of thirteen to fifteen sharp, triangular, backward directed denticles extends to the posterior extremity. The first denticle is smaller than the second and is slightly out of line with the other denticles. From the anterior end the denticles decrease in size until they are minute at the posterior end. The outer margins are gently curved and the jaw may be slightly narrower at the mid-area.

A large deep fossa occupies the complete upper side of the jaw. The margin of the fossa is slightly thickened and rounded. The jaw measures from 0.45 mm. to 0.72 mm. in length.

In a general way *M. farrari* is similar to *M. arduus*. They differ in the shape and size of the denticles, the shape of the anterior and posterior ends, and the curvature of the outer margins. *M. farrari* is similar to *M. marginatus* (Eller) except for the arrangement of the denticles, the shape of the posterior end, and the shape and thickness of the outer margins.

Occurrence: The species was found only in the Rockland at Belleville, Ontario, and at Lowville, New York.

Type: The holotype is in the Carnegie Museum, number 25,197.

MARPHYSAITES, **new genus**

The mandible consists of two shafts joined or articulated at the anterior end of the inner margin. The shafts of the mandible are elongate, wide anteriorly and taper to a pointed or blunt posterior end. The thickened anterior margin is straight or curved. The shafts may curve outward or be nearly straight. The surface of the mandible is convex or flattened.

Genotype, *Marphysaites aptus* sp. nov.

Mandibles of several recent species of the genus *Marphysa* Savigny resemble those of *Marphysaites* in a general way. A terminal beveled portion present in many recent forms may be missing at the anterior of the shaft of *Marphysaites*.

Marphysaites aptus sp. nov.

Mandible, plate VII, fig. 26.

The mandible is wide anteriorly and the shaft tapers gradually to an acute posterior end. Specimens measure from 0.67 mm. to 1.1 mm. in length. The thickened anterior margin is straight or slightly incurved to the shallow middle angle at the point of attachment of the shafts. The margin of articulation is irregular and the area of possible overlap is convex. The inner margin from the point of attachment curves outward to the posterior end. The outer margin is irregularly curved. The mandible is convex except for a concave area adjacent to the anterior margin and the area of overlap or articulation.

It is possible that a terminal beveled portion attached to the anterior end of the mandible is missing. A form of this type with its nearly straight

anterior margin might be considered a carrier on first examination. Short paired carriers either in recent or fossil forms have not been observed that do not have straight inner margins for articulation. The mandibles of some recent forms may have straight or curved outer margins while the inner margins of the shafts may be curved or joined along straight sides. Eisenack (1939), Tafel C, illustrates carriers with straight inner margins which have a slight resemblance to *Marphysaites aptus*. It may be possible that some of Eisenack's forms are mandibles. The difference between the mandible, *Marphysaites aptus* and carriers may be observed in three articulated specimens described by Hinde (1896), Eller (1934, vol. xxii), and Eller (1934, vol. xxiv).

Occurrence: Mandibles were found in the Upper Cobourg at Collingwood, Ontario, and in the Rockland at Lakefield, Ontario.

Type: The holotype is in the Carnegie Museum, number 25,306.

Genus ORTHOPELTA, Eisenack, 1939

Orthopelta ? femoralis sp. nov.

Carrier (?), plate VII, figs. 28, 29.

The carrier is long, narrow, and rounded. At the anterior end are three knob-like projections that appear to have articulating surfaces. The shaft is long and slightly bent. The posterior end widens slightly. A deep groove is present between two rounded knobs. It also appears to have articulating surfaces. Specimens measure from 1.18 mm. to 1.32 mm.

A number of fragments and specimens of this type were found in the residues but were rejected as something unrelated to polychaetes. However, there is a slight resemblance to some forms figured by Eisenack (1939) and to certain types of carriers of recent annelids. The questionable part of *Orthopelta ? femoralis* is the enlarged posterior extremity. All known recent and fossil carriers taper to a pointed end. Some carriers of modern forms are hooked or joined. It is possible that paired carriers of this type were articulated and evidence is present on the shaft and at the anterior and posterior ends.

Occurrence: The figured specimens are from the Rockland, Paquette Rapids, Ottawa River, Quebec.

Types: The holotype is in the Carnegie Museum, number 25,642, also a paratype, number 25,643.

***Orthopelta ? bifidus* sp. nov.**

Carrier (?); plate VII, fig. 30.

The paired carriers are elongate, narrow, and angular. The figured specimen is 0.78 mm. in length. Along the center of the shaft is a groove or crack that is considered to be the articulating edge between two carriers. At the anterior end the carriers separate and form a notch between each other. A small indentation is present at the anterior end of each carrier. The posterior end is also notched but the ends of the carrier may be broken. The surface of the carrier is quite irregular and may be crushed.

Orthopelta ? bifidus appears more likely to be a carrier than *O. ? femoralis*. A form, *O. muronata* Eisenack (1939), figure 10, resembles *O. ? bifidus* slightly at the anterior end but differs posteriorly. Carriers of modern polychaetes are usually articulated only for a short distance at the anterior part.

Occurrence: The figured specimen is from the Rockland at Paquette Rapids, Ottawa River, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,644.

Genus *SILUROPelta*, Eisenack, 1939

***Siluropelta calcaratus* sp. nov.**

Mandible, plate VII, fig. 31.

The mandible consists of a plate with an articulation edge along one side. A long, thin, lateral spine or spur is present at the anterior end of the outer margin. The anterior margin is rounded and then incurved to a small protuberance at the point of articulation. The outer margin is straight while the posterior margin and the margin of articulation is broken. The surfaces of the mandible are irregular and it was not determined which was the upper or lower side. Both the mandible and the lateral spine measure 0.45 mm. in length. The total width of the left and right plates would also be 0.45 mm.

Only one side or plate of the mandible is available for description. Eisenack (1939) described a number of mandibles from the Silurian of the Baltic that are of the same general nature. None, however, is similar enough to make an exact comparison. Most mandibles of modern polychaetes do not possess spines of the length of *Siluropelta calcaratus*. One

species, *Paramarphysa obtusa* Verrill, does have long spines but on mandibles of a different character.

Occurrence: The figured specimen is from the St. Maurice quarry, north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,555.

Genus DIOPATRAITES, Eller, 1938

Diopatraites tricuspis sp. nov.

Mandible, plate VII, figs. 32, 33.

The mandible is long, narrow, and triangular in cross section. The figured specimen measures 0.99 mm. in length. The frontal plate is small and curved in outline. Three conical sharp-pointed teeth or denticles are present at the anterior end of the frontal plate. The remainder of the anterior edge of the frontal plate is slightly curved and extends as far forward as the denticles. The shaft is curved and tapers to a pointed posterior. The sides of the shaft are concave.

Diopatraites tricuspis is similar to *D. conformis* Eller except for the width of the frontal plate and the shape of the shaft.

Occurrence: The figured specimen is from the St. Maurice quarry, north of Three Rivers, Quebec.

Type: The holotype is in the Carnegie Museum, number 25,556.

Diopatraites fustis ? Eller

Mandible

Diopatraites fustis Eller, 1942, Annals, Carnegie Museum, vol. 29, p. 250, pl. 3, figs. 24-27.

Mandibles are not common in the Trenton beds and only a few fragments were found. One rather complete specimen was obtained from the Rockland at Paquette Rapids, Ottawa River, Quebec. The posterior end is missing but it probably measured 1.65 mm. in length. *Diopatraites fustis* Eller from the Erindale, Upper Ordovician at Streetsville, Ontario, is so similar to the specimen from Paquette Rapids that it does not seem plausible to draw a specific difference. The Paquette Rapids specimen has a heavier and flatter shaft and a more irregular concave area adjacent to the frontal plate than do those from Streetsville.

Diopatraites sp. indet.

Mandible

A broken specimen of a *Diopatraites* from the Hull, Philemon Island, Ottawa River at Hull, Quebec, seems worth mentioning. Since about half of the frontal plate is missing, a specific identification will not be attempted. The mandible is small, probably not more than 1 mm. in length. The frontal plate is narrow and set at about a forty-five degree angle with the shaft. The posterior end of the plate extends a short distance beyond the end of the shaft but not as far as in *Diopatraites fustis* Eller (1942). The shaft is wide and flattened and similar to *Diopatraites conformis* Eller (1938). Most characters would suggest that the mandible is closely related to *Diopatraites fustis* Eller from the Erindale, Upper Ordovician at Streetsville, Ontario.

BIBLIOGRAPHY

EISENACK, A. E.

1939. Zeits. Geschiebeforschung, Bd. 15, H. 3, pp. 153-176, 13 figs., 3 pls.

ELLER, E. R.

1934. Ann. Carnegie Mus., vol. 22, pp. 303-316, pls. 22, 23.
1934. Ann. Carnegie Mus., vol. 24, pp. 51-56, pl. 1.
1936. Ann. Carnegie Mus., vol. 25, pp. 73-76, pl. 11.
1938. Ann. Carnegie Mus., vol. 27, pp. 275-286, pls. 28, 29.
1940. Ann. Carnegie Mus., vol. 28, pp. 9-46, pls. 1-7.
1941. Ann. Carnegie Mus., vol. 28, pp. 323-340, pls. 37, 38.
1942. Ann. Carnegie Mus., vol. 29, pp. 241-270, pls. 1-3.
1944. American Midland Nat., vol. 32, pp. 732-755, pls. 1-4.

HINDE, A. J.

1879. Quart. Jour. Geol. Soc., London, vol. 35, pp. 370-389, pls. 18-20.
1880. Quart. Jour. Geol. Soc., London, vol. 36, pp. 368-378, pl. 14.
1882. Bihang till k. Svensk Akad. Handl, vol. 7, N:05, pp. 1-28, pls. 1-3.
1896. Quart. Jour. Geol. Soc., London, vol. 52, pp. 448-450, pl. 22.

JOHNSON, W. A.

1911. Geol. Surv., Canada, Summ. Rept. for 1910, pp. 188-192.

KAY, G. M.

1937. Bull. Geol. Soc. America, vol. 48, pp. 233-302, 10 pls. 13 figs.
1942. Bull. Geol. Soc. America, vol. 53, pp. 585-646, 7 pls. 7 figs.
1943. American Jour. Sci., vol. 241, no. 10, pp. 597-606.

OKULITCH, V. J.

1939. American Jour. Sci., vol. 237, pp. 81-93.

RAYMOND, P. E.

1914. Geol. Surv., Canada, Summ. Rept. for 1912, pp. 342-350.

SEARIGHT, W. V.

1923. Iowa Acad. Sci., vol. 30, pp. 433-436.

SINCLAIR, G. W.

1942. Bull. Geol. Soc. America, vol. 53, no. 12, pt. 2, p. 1833.

STAUFFER, C. R.

1933. Bull. Geol. Soc. America, vol. 44, pp. 1173-1218, pls. 59-61.
1939. Jour. Paleon., vol. 13, no. 5, pp. 500-511, pls. 57-58.

ZEBRA, K.

1935. Bull. Inter. Acad. Sci., Boheme, pp. 1-9, pls. 1-2.

EXPLANATION OF PLATE I

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIGS. 1-3.

Lumbriconereites linki sp. nov.
Maxilla I, left jaw (25,285)
Upper, under and lateral sides.
Lakefield, Ontario.

FIGS. 4-6.

L. concertatorius sp. nov.
Maxilla I, left jaw (25,308).
Lateral, under and upper sides.
Collingwood, Ontario.

FIGS. 7, 8.

L. curvus sp. nov.
Maxilla I, right jaw (25,362).
Under and upper sides.
Gamebridge, Ontario.

FIGS. 9-11.

L. projectus sp. nov.
Maxilla I, left jaw (25,273).
Under, upper and lateral sides.
Lindsay, Ontario.

FIGS. 12, 13.

L. crassus sp. nov.
Maxilla I, left jaw (25,304).
Upper and under sides.
Lakefield, Ontario.

FIGS. 14, 15.

L. langae sp. nov.
Maxilla I, left jaw (25,188).
Upper and under sides.
Collingwood, Ontario.

FIGS. 16-18.

L. jenningsi sp. nov.
Maxilla I, right jaw (25,259).
Upper, under and lateral sides.
Kirkfield, Ontario.

FIGS. 19-21.

Lumbriconereites irregularis sp. nov.
Maxilla I, left jaw (25,200).
Lateral, under and upper sides.
Napancee, Ontario.

FIGS. 22-24.

L. macmillani sp. nov.
Maxilla I, right jaw (25,211).
Upper, lateral and under sides.
Copenhagen, New York.

FIGS. 25, 26.

L. johnsoni sp. nov.
Maxilla I, left jaw (25,237).
Upper and under sides.
Lindsay, Ontario.

FIGS. 27, 28.

L. triquetrus sp. nov.
Maxilla I, left jaw (25,361).
Under and upper sides.
Gamebridge, Ontario.

FIGS. 29, 30.

L. bicornis sp. nov.
Maxilla I, right jaw (25,359).
Upper and under sides.
Watertown, New York.

FIGS. 31-33.

L. longae sp. nov.
Maxilla I, left jaw (25,341).
Under, lateral and upper sides.
Collingwood, Ontario.

FIGS. 34-36.

L. tuberosus sp. nov.
Maxilla I, right jaw (25,191).
Lateral, under and upper sides.
Lindsay, Ontario.



EXPLANATION OF PLATE II

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIGS. 1, 2.

Lumbriconereites kosinskii sp. nov.
Maxilla I, left jaw (25,320).
Upper and lateral sides.
Collingwood, Ontario.

FIGS. 17, 18.

Lumbriconereites assimilis sp. nov.,
Maxilla I, right jaw (25,219).
Lateral and under sides.
Peterborough, Ontario.

FIGS. 3, 4.

L. dissimilis sp. nov.
Maxilla I, right jaw (25,453).
Under and lateral sides.
Three Rivers, Quebec.

FIG. 19.

L. assimilis sp. nov.
Maxilla I, left jaw.
Lateral side.
Lindsay, Ontario.

FIGS. 5, 6.

L. dissimilis sp. nov.
Maxilla I, right jaw (25,454).
Under and lateral sides.
Three Rivers, Quebec.

FIG. 20.

L. assimilis sp. nov.
Maxilla I, right jaw (25,215).
Lateral side.
Lindsay, Ontario.

FIGS. 7, 8.

L. angustifossus sp. nov.
Maxilla I, right jaw (25,433).
Under and lateral sides.
Craigleith, Ontario.

FIG. 21.

L. assimilis sp. nov.
Maxilla I, right jaw (25,217).
Under side.
Lindsay, Ontario.

FIGS. 9, 10.

L. ? okulitchi sp. nov.
Maxilla I, right jaw (25,455).
Lateral and under sides.
Three Rivers, Quebec.

FIGS. 22, 23.

Arabellites rectidens ? Eller
Maxilla I, right jaw (25,328).
Under and upper side.
Henderson, New York.

FIGS. 11-13.

L. assimilis sp. nov.
Maxilla I, right jaw (25,221).
Lateral, under and upper sides.
Dunsford, Ontario.

FIGS. 24, 25.

A. rectidens ? Eller
Maxilla I, right jaw (25,327).
Under and under sides.
Port Hope, Ontario.

FIGS. 14-16.

L. assimilis sp. nov.
Maxilla I, left jaw (25,213).
Lateral, upper and under sides.
Kirkfield, Ontario.

FIGS. 26, 27.

A. ? claytonae sp. nov.
Maxilla I, right jaw (25,303).
Upper and under sides.
Lakefield, Ontario.

Plate II; explanation continued from previous page.

FIGS. 28, 29.

Arabellites ? doulti sp. nov.
Maxilla I, right jaw (25,289).
Under and upper sides.
Dalrymple, Ontario.

FIGS. 30, 31.

Ildraites camurus sp. nov.
Maxilla I, left jaw (25,182).
Under and upper sides.
Belleville, Ontario.

FIGS. 32, 33.

I. camurus sp. nov.
Maxilla I, left jaw (25,181).
Upper and under sides.
Collingwood, Ontario.

FIGS. 34, 35.

I. camurus sp. nov.
Maxilla I, left jaw (25,183).
Under and upper sides.
Lowville, New York.

FIGS. 36, 37.

Ildraites camurus sp. nov.
Maxilla I, left jaw (25,184).
Under and upper sides.
Lowville, New York.

FIGS. 38-40.

I. fuehreri sp. nov.
Maxilla I, left jaw (25,225).
Upper, under and lateral sides.
Lindsay, Ontario.

FIGS. 41-43.

I. rarus sp. nov.
Maxilla I, left jaw (25,243).
Upper, lateral and under sides.
Lindsay, Ontario.



EXPLANATION OF PLATE III

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIGS. 1, 2.

Leodicites brooksi sp. nov.
Maxilla II, right jaw (25,249).
Lateral side.
Lakefield, Ontario.

FIGS. 17, 18.

L. collatatus sp. nov.
Maxilla II, right jaw (25,630).
Under and upper sides.
Paquette Rapids, Quebec.

FIGS. 3, 4.

L. brooksi sp. nov.
Maxilla II, right jaw (25,250).
Lateral side.
Lakefield, Ontario.

FIGS. 19, 20.

L. exilis sp. nov.
Maxilla II, right jaw (25,363).
Lateral sides.
Collingwood, Ontario.

FIGS. 5-8.

L. biformis sp. nov.
Maxilla II, right jaw (25,331)
Under, lateral, upper and lateral
sides.
Lindsay, Ontario.

FIGS. 21, 22.

L. arquatus sp. nov.
Maxilla II, right jaw (25,240).
Lateral sides.
Lindsay, Ontario.

FIGS. 9, 10.

L. artus sp. nov.
Maxilla II, right jaw (25,295).
Lateral side.
Gamebridge, Ontario.

FIGS. 23, 24.

L. agostini sp. nov.
Maxilla II, left jaw (25,248).
Lateral sides.
Lakefield, Ontario.

FIGS. 11, 12.

L. semiquadratus sp. nov.
Maxilla II, right jaw (25,251).
Lateral sides.
Lakefield, Ontario.

FIGS. 25, 26.

L. anticus sp. nov.
Maxilla II, right jaw (25,270).
Lateral sides.
Gamebridge, Ontario.

FIGS. 13, 14.

L. antefixus sp. nov.
Maxilla II, right jaw (25,436).
Lateral and upper sides.
Kirkfield, Ontario.

FIGS. 27-29.

L. absolutus sp. nov.
Maxilla II, left jaw (25,245).
Upper and under sides.
Lowville, New York.

FIGS. 15, 16.

L. ? continuus sp. nov.
Maxilla II, left jaw (25,357).
Lateral sides.
Belleville, Ontario.

FIGS. 30-32.

L. angustisulcus sp. nov.
Maxilla II, right jaw (25,518).
Under, upper and lateral sides.
Three Rivers, Quebec.

Plate III; explanation continued from previous page.

FIGS. 33-35.

Leodicites breviculus sp. nov.
Maxilla II, right jaw (25,231).
Lateral, upper and under sides.
Collingwood, Ontario.

FIGS. 36, 37.

L. breviculus sp. nov.
Maxilla II, right jaw (25,228).
Lateral and under sides.
Lindsay, Ontario.

FIGS. 38-40.

L. clementi sp. nov.
Maxilla II, right jaw (25,297).
Under, lateral and upper sides.
Lakefield, Ontario.

FIGS. 41-43.

Leodicites buris sp. nov.
Maxilla II, right jaw (25,321).
Lateral, under and upper sides.
Collingwood, Ontario.

FIG. 44.

L. bisulcus sp. nov.
Maxilla II, right jaw (25,356).
Lateral sides.
Collingwood, Ontario.

FIGS. 45, 46.

L. angulus sp. nov.
Maxilla II, right jaw (25,343).
Under and upper sides.
Collingwood, Ontario.



EXPLANATION OF PLATE IV

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIGS. 1, 2.

Leodicites convallis sp. nov.
Maxilla III, left jaw (25,373).
Upper and under sides.
Lindsay, Ontario.

FIG. 3.

L. convallis sp. nov.
Maxilla III, left jaw (25,517).
Lateral side.
Three Rivers, Quebec.

FIGS. 4, 5.

L. corbis sp. nov.
Maxilla III, left jaw (25,631).
Upper and under sides.
Paquette Rapids, Quebec.

FIGS. 6, 7.

Staurocephalites appositus sp. nov.
Maxilla II, left jaw (25,428).
Under and upper sides.
Kirkfield, Ontario.

FIGS. 8, 9.

S. appositus sp. nov.
Maxilla II, right jaw (25,489).
Upper and lateral sides.
Three Rivers, Quebec.

FIGS. 10, 11.

S. kayi sp. nov.
Maxilla II, left jaw (25,151).
Upper and under sides.
Peterborough, Ontario.

FIGS. 12, 13.

S. aduncus sp. nov.
Maxilla II, right jaw (25,267).
Upper and under sides.
Millington, Ontario.

FIG. 14.

Staurocephalites arcus sp. nov.
Maxilla III, left jaw (25,540).
Lateral side.
Three Rivers, Quebec.

FIG. 15.

S. ? arcus sp. nov.
Maxilla III, left jaw (25,293).
Lateral side.
Collingwood, Ontario.

FIG. 16.

S. admirabilis sp. nov.
Maxilla II, left jaw (25,323).
Upper side.
Collingwood, Ontario.

FIGS. 17, 18.

S. admirabilis sp. nov.
Maxilla II, left jaw (25,324).
Under and upper sides.
Collingwood, Ontario.

FIGS. 19, 20.

S. ? absimilis sp. nov.
Maxilla II or III, right jaw
(25,354).
Lateral and under sides.
Lakefield, Ontario.

FIGS. 21-23.

S. bijugus sp. nov.
Maxilla II, right or left jaw
(25,500).
Lateral and under sides.
Three Rivers, Quebec.

FIG. 24.

S. cuneiformis sp. nov.
Maxilla III, right jaw (25,355).
Under side.
Lowville, New York.

Plate IV; explanation continued from previous page.

FIG. 25.

Staurocephalites absis sp. nov.
Maxilla III, left jaw (25,164).
Lateral side.
Collingwood, Ontario.

FIGS. 26-28.

S. ? triplus sp. nov.
Maxilla II, right jaw (25,212).
Under, lateral and upper sides.
Belleville, Ontario.

FIGS. 29, 30.

S. agriodos sp. nov.
Maxilla III, right jaw (25,353).
Upper and under sides.
Kirkfield, Ontario.

FIG. 31.

S. nettingi sp. nov.
Maxilla II, left jaw (25,309).
Under side.
Lakefield, Ontario.

FIGS. 32, 33.

Staurocephalites mierowae sp. nov.
Maxilla II, left jaw (25,199).
Under and lateral sides.
Lakefield, Ontario.

FIGS. 34, 35.

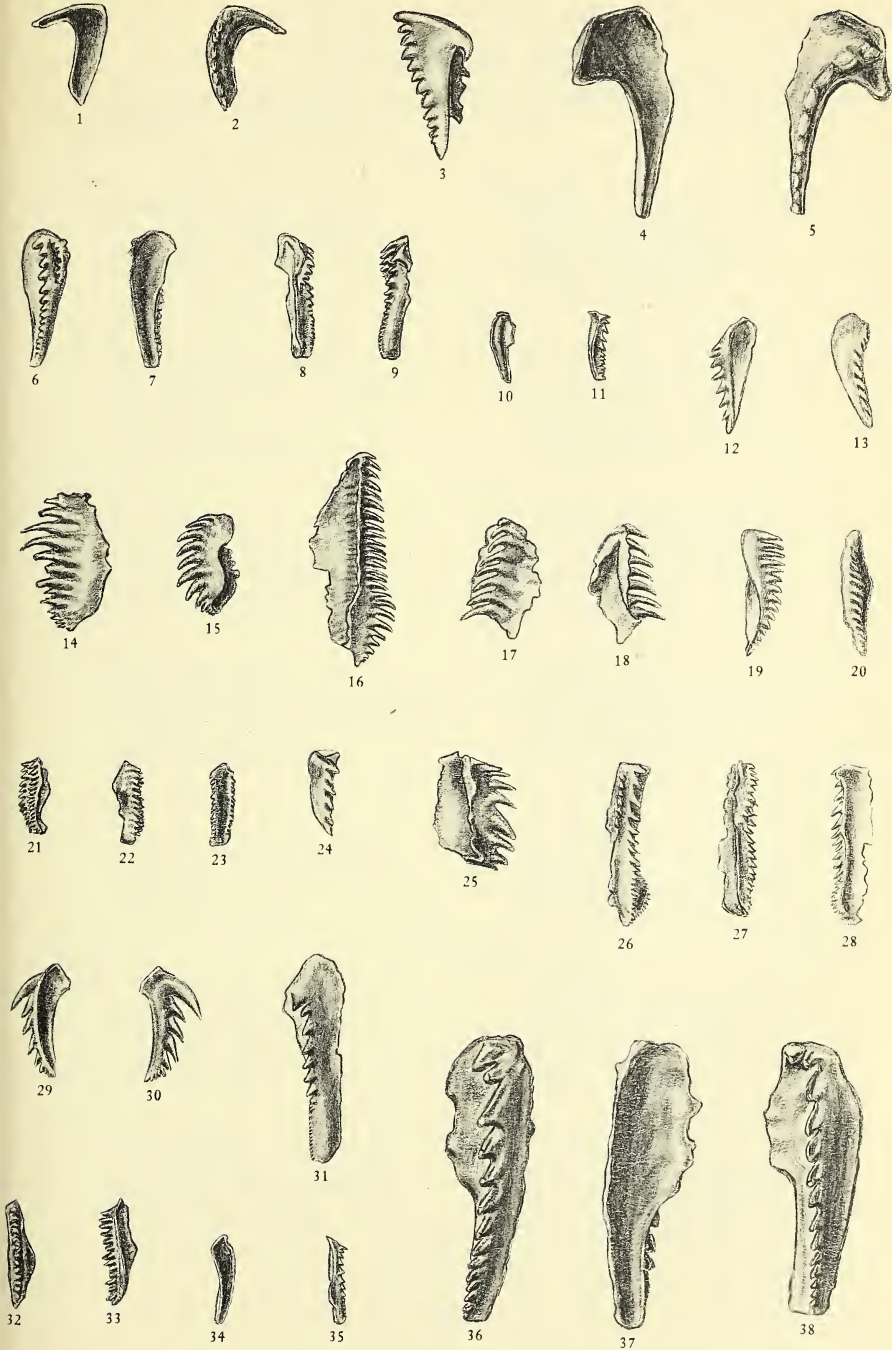
S. heppenstallae sp. nov.
Maxilla II, right jaw (25,145).
Upper and lateral sides.
Hull, Quebec.

FIG. 36.

S. paquettensis sp. nov.
Maxilla II, left jaw (25,637).
Under side.
Paquette Rapids, Quebec.

FIGS. 37, 38.

S. paquettensis sp. nov.
Maxilla II, left jaw (25,636).
Upper and under sides.
Paquette Rapids, Quebec.



EXPLANATION OF PLATE V

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIG. 1.

Enoniles adversus sp. nov.
Maxilla II, left jaw (25,372).
Under side.
Collingwood, Ontario.

FIGS. 12, 13.

Enoniles imparientatus sp. nov.
Maxilla II, (25,365).
Upper and under sides.
Port Hope, Ontario.

FIG. 2.

Æ. ? intrinsecus sp. nov.
Maxilla II, left jaw (25,358).
Lateral side.
Dalrymple, Ontario.

FIG. 14.

Æ. bidwelli sp. nov.
Maxilla I, right jaw (25,301).
Upper side.
Kirkfield, Ontario.

FIGS. 3, 4.

Æ. fissilis sp. nov.
Maxilla I, right jaw (25,282).
Upper and under sides.
Kirkfield, Ontario.

FIGS. 15, 16.

Palaenoniles acutus sp. nov.
Maxilla II, left jaw (25,201).
Upper and under sides.
Lindsay, Ontario.

FIGS. 5, 6.

Æ. ? dubius sp. nov.
Maxilla II or III, left jaw (25,375).
Upper and under sides.
Kirkfield, Ontario.

FIGS. 17, 18.

P. dillae sp. nov.
Maxilla II, left jaw (25,333).
Under and upper sides.
Cobourg, Ontario.

FIG. 7.

Æ. bittingsae sp. nov.
Maxilla I, right jaw (25,268).
Upper side.
Millington, Ontario.

FIGS. 19, 20.

P. dillae sp. nov.
Maxilla II, left jaw (25,335).
Under and upper sides.
Port Hope, Ontario.

FIGS. 8, 9.

Æ. coggeshalli sp. nov.
Maxilla II, left jaw (25,208).
Upper and lateral sides.
Lindsay, Ontario.

FIGS. 21, 22.

P. castigatus sp. nov.
Maxilla II, left jaw (25,234).
Upper and under sides.
Lindsay, Ontario.

FIGS. 10, 11.

Æ. coggeshalli sp. nov.
Maxilla II, right jaw (25,209).
Upper and under sides.
Collingwood, Ontario.

FIGS. 23, 24.

P. castigatus sp. nov.
Maxilla II, left jaw (25,235).
Upper and under sides.
Dexter, New York.

Plate V; explanation continued from previous page.

FIGS. 25, 26.

Paleænonites henryi sp. nov.
Maxilla II, left jaw (25,143).
Upper and under sides.
Lindsay, Ontario.

FIGS. 27, 28.

P. pennatus sp. nov.
Maxilla II, left jaw (25,272).
Upper and under sides.
Lindsay, Ontario.

FIG. 29.

P. clinatus sp. nov.
Maxilla II, left jaw (25,463).
Upper side.
Three Rivers, Quebec.

FIG. 30.

P. clinatus sp. nov.
Maxilla II, left jaw (25,464).
Upper side.
Three Rivers, Quebec.

FIGS. 31, 32.

P. clinatus sp. nov.
Maxilla II, right jaw (25,414).
Upper and under sides.
Kirkfield, Ontario.

FIGS. 33, 34.

Paleænonites frickei sp. nov.
Maxilla II, left jaw (25,266).
Under and upper sides.
Collingwood, Ontario.

FIGS. 35, 36.

P. comptus sp. nov.
Maxilla II, left jaw (25,176).
Under and upper sides.
Collingwood, Ontario.

FIGS. 37, 38.

P. davisae sp. nov.
Maxilla II, right jaw (25,246).
Upper and under sides.
Lindsay, Ontario.

FIGS. 39, 40.

P. circumscriptus sp. nov.
Maxilla II, left jaw (25,269).
Upper and under sides.
Lindsay, Ontario.

FIGS. 41, 42

P. circumscriptus sp. nov.
Maxilla II, left jaw (25,350).
Upper and under sides.
Peterborough, Ontario.



EXPLANATION OF PLATE VI

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIGS. 1-3.

Eunicites tolmachoffi sp. nov.
Maxilla III or IV, right jaw
(25,547).
Under, upper and lateral sides.
Three Rivers, Quebec.

FIG. 4.

E. tolmachoffi sp. nov.
Maxilla III or IV, right jaw
(25,545).
Lateral side.
Three Rivers, Quebec.

FIGS. 5, 6.

E. tolmachoffi sp. nov.
Maxilla III or IV, right jaw
(25,265).
Under and upper side.
Cobourg, Ontario.

FIG. 7.

E. tolmachoffi sp. nov.
Maxilla III or IV, left jaw (25,261).
Lateral side.
Lindsay, Ontario.

FIGS. 8-10.

E. geisacanthus sp. nov.
Maxilla IV or V, right jaw (25,537).
Upper and lateral sides.
Three Rivers, Quebec.

FIG. 11.

E. whiteae sp. nov.
Maxilla V ?, left jaw (25,345).
Lateral side.
Lindsay, Ontario.

FIG. 12.

E. whiteae sp. nov.
Maxilla V ?, left jaw (25,536).
Lateral side.
Three Rivers, Quebec.

FIG. 13.

Eunicites compressus sp. nov.
Maxilla IV or V, left jaw (25,553).
Upper side.
Three Rivers, Quebec.

FIG. 14.

E. compressus sp. nov.
Maxilla IV or V, right jaw (25,380).
Upper side.
Lakefield, Ontario.

FIG. 15.

E. barbaricus sp. nov.
Maxilla IV or V, left jaw (25,432).
Upper side.
Kirkfield, Ontario.

FIG. 16.

E. barbaricus sp. nov.
Maxilla IV or V, left jaw (25,605).
Upper side.
Three Rivers, Quebec.

FIG. 17.

E. toddi sp. nov.
Maxilla III or IV, right jaw
(25,232).
Upper side.
Lindsay, Ontario.

FIGS. 18, 19.

Ungulites confertus sp. nov.
Maxilla III, right jaw (25,542).
Under and upper sides.
Three Rivers, Quebec.

FIGS. 20, 21.

Eunicites sweadneri sp. nov.
Maxilla I, left jaw (25,325).
Under and lateral sides.
Collingwood, Ontario.

Plate VI; explanation continued from previous page.

FIG. 22.

Eunicites kirkfieldensis sp. nov.
Maxilla IV, right jaw (25,431).
Under side.
Kirkfield, Ontario.

FIG. 23.

E. twomeyi sp. nov.
Maxilla ?, left jaw (25,271).
Upper side.
Lindsay, Ontario.

FIG. 24.

E. acis sp. nov.
Maxilla IV, right jaw (25,258).
Upper side.
Gamebridge, Ontario.

FIG. 25.

E. colossus sp. nov.
Maxilla IV or V, left jaw (25,549).
Upper side.
Three Rivers, Quebec.

FIG. 26.

E. acis sp. nov.
Maxilla V, left jaw (25,260).
Upper side.
Dunsford, Ontario.

FIGS. 27, 28.

E. aculeus sp. nov.
Maxilla V ?, left jaw (25,344).
Upper and under sides.
Trenton Falls, New York.

FIG. 29.

Eunicites conjectus sp. nov.
Maxilla III, right jaw (25,558).
Lateral side.
Kirkfield, Ontario.

FIGS. 30, 31.

E. planoconvexus sp. nov.
Maxilla IV, left jaw (25,604).
Under and upper sides.
Paquette Rapids, Quebec.

FIG. 32.

E. plackae sp. nov.
Maxilla I or V, left jaw (25,247).
Lateral side.
Peterborough, Ontario.

FIG. 33.

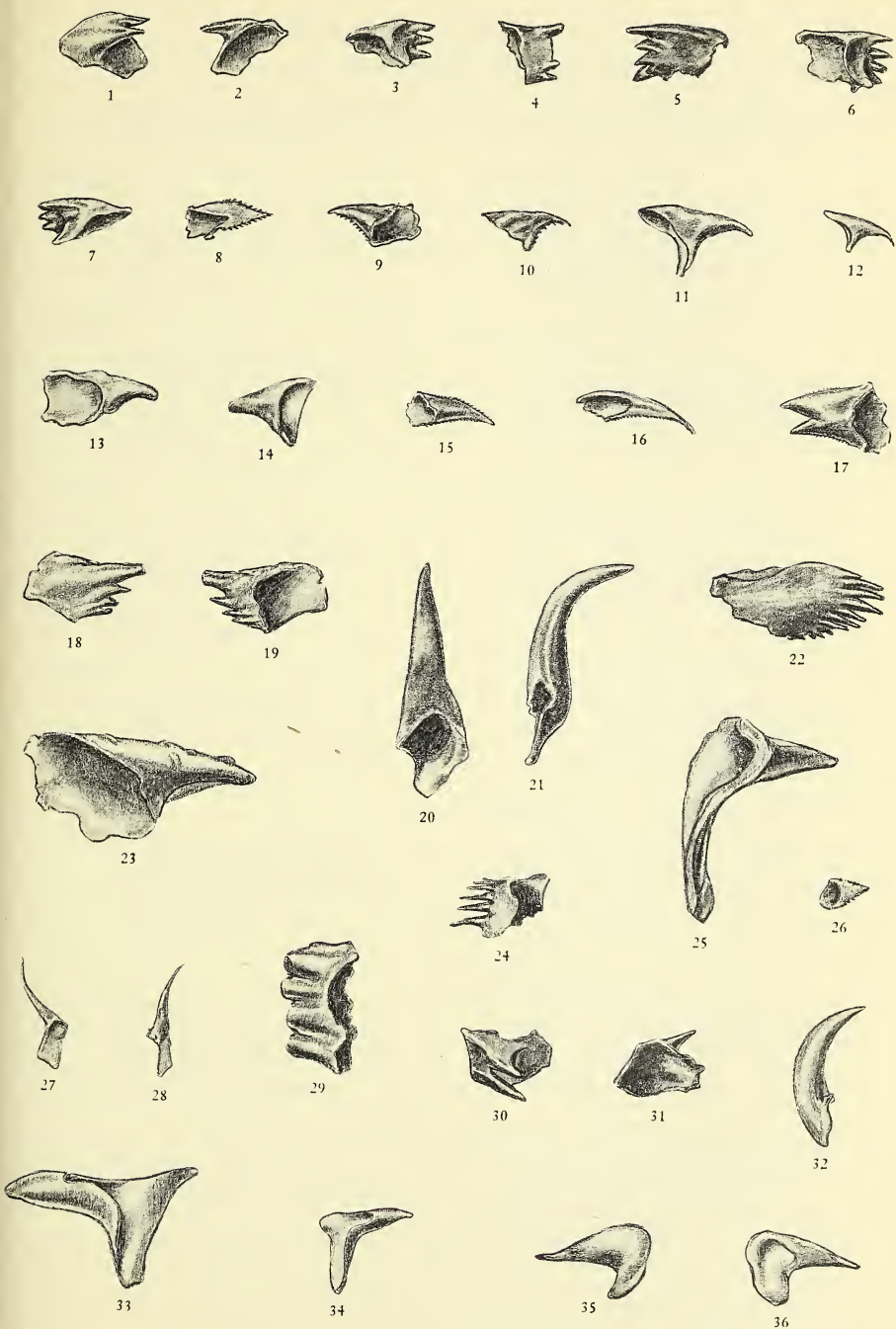
E. cavus sp. nov.
Maxilla V, right jaw (25,548).
Upper side.
Three Rivers, Quebec.

FIG. 34.

E. cavus sp. nov.
Maxilla V, left jaw (25,291).
Upper side.
Kirkfield, Ontario.

FIGS. 35, 36.

E. ansatus sp. nov.
Maxilla V, left jaw (25,543).
Under and upper sides.
Three Rivers, Quebec.



EXPLANATION OF PLATE VII

Figures magnified about 28 times.

Numbers in parentheses indicate the Carnegie Museum catalogue numbers of the respective type specimens.

FIG. 1.

Ungulites longidentatus sp. nov.
Maxilla III or IV, left jaw (25,376).
Lateral side.
Lindsay, Ontario.

FIG. 2.

U. sumnerae sp. nov.
Maxilla III or IV, right jaw
(25,205).
Upper side.
Lindsay, Ontario.

FIG. 3.

U. sumnerae sp. nov.
Maxilla III or IV, right jaw
(25,206).
Upper side.
Lindsay, Ontario.

FIG. 4.

U. bifurcus sp. nov.
Maxilla III or IV, left jaw (25,379).
Upper side.
Lakefield, Ontario.

FIGS. 5, 6.

Nereidavus avinoffi sp. nov.
Maxilla I, right jaw (25,171).
Under and lateral sides.
Lindsay, Ontario.

FIGS. 7, 8.

N. artatus sp. nov.
Maxilla I, right jaw (25,346).
Upper and lateral sides.
Copenhagen, New York.

FIG. 9.

N. alatus sp. nov.
Maxilla I, right jaw (25,165).
Upper side.
Lakefield, Ontario.

FIGS. 10, 11.

Nereidavus alatus sp. nov.
Maxilla I, right jaw (25,166).
Lateral and under sides.
Collingwood, Ontario.

FIGS. 12-14.

N. angulosus sp. nov.
Maxilla I, left jaw (25,224).
Upper, lateral and under sides.
Lindsay, Ontario.

FIGS. 15, 16.

N. angulosus sp. nov.
Maxilla I, left jaw (25,223).
Upper and under sides.
Lakefield, Ontario.

FIGS. 17-19.

Marleneites millerae sp. nov.
Maxilla II, left jaw (25,161).
Under, lateral and upper sides.
Peterborough, Ontario.

FIGS. 20, 21.

M. arduus sp. nov.
Maxilla II, right jaw (25,153).
Under and upper sides.
Lindsay, Ontario.

FIGS. 22, 23.

M. arduus sp. nov.
Maxilla II, right jaw (25,154).
Under and upper sides.
Collingwood, Ontario.

FIG. 24.

Staurocephalites mccallae sp. nov.
Maxilla II, right jaw (25,155).
Lateral side.
Lindsay, Ontario.

Plate VII; explanation continued from previous page.

FIG. 25.

Marleneites aureus sp. nov.
Maxilla II, right jaw (25,162).
Upper side.
Lowville, New York.

FIG. 26.

Marphysailes aptus sp. nov.
Mandible (25,306).
Collingwood, Ontario.

FIG. 27.

Marleneites farrari sp. nov.
Maxilla II, right jaw (25,197).
Lateral side.
Lowville, New York.

FIG. 28.

Orthopelta ? femoralis sp. nov.
Carrier ? (25,643).
Paquette Rapids, Quebec.

FIG. 29.

Orthopelta femoralis sp. nov.
Carrier ? (25,642).
Paquette Rapids, Quebec.

FIG. 30.

O. ? bifidus sp. nov.
Carrier ? (25,644).
Paquette Rapids, Quebec.

FIG. 31.

Siluropelta calcaratus sp. nov.
Mandible (25,555).
Three Rivers, Quebec.

FIGS. 32, 33.

Diopatraites tricuspis sp. nov.
Mandible (25,556).
Three Rivers, Quebec.



507.73
24P6842



ART. XIII. A REVIEW OF THE BOLETES (FUNGI)
OF WESTERN PENNSYLVANIA

BY LEROY K. HENRY

(PLATES I-III)

The Boletaceae are fleshy and mostly centrally stipitate pore fungi growing usually on the ground where they are saprophytic upon vegetation and bring about its decay. The pore layer is easily separated from the thick, convex pileus. In size the sporophores vary from the very small *Boletus piperatus* to the large *Boletus felleus*, the latter sometimes attaining a diameter of forty centimeters. The flesh of many species changes to blue when cut or bruised. The majority of the boletes are edible, but a few are poisonous, especially those with bright red pore mouths and those changing to blue when wounded.

The Fistulinaceae are distinguished by their fleshy, laterally attached sporophores and by the separate hollow tubes hanging from the under side of the pileus. The beefsteak fungus, *Fistulina hepatica*, growing in nearly all temperate regions on stumps and trunks of deciduous trees, is edible when young.

This review is based upon the specimens in the Herbarium of the Carnegie Museum, a representative number of which have been checked and some determined by Dr. W. H. Snell.

As the eastern boundary of Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton Counties. The initials following the collection data are to be interpreted as follows: L.K.H.—L. K. Henry; O.E.J.—O. E. Jennings; D.R.S.—D. R. Sumstine; M.B.K.—Marie B. Knauz; H.S.W.—H. S. Wieand. The numerals following the author's initials are his field numbers.

BOLETACEAE

Synopsis of the Genera

- I. Tubes easily separable from the pileus and from each other. *Boletus*
- II. Tubes not easily separable from the pileus and not at all from each other.....1

MAR 25 '46

1. Tubes arranged radially in rows, usually with more or less prominent veins between.....*Boletinus*
2. Tubes not radially arranged in rows; pileus and stipe floccose scaly.....*Strobilomyces*

Key to *Boletinus*

I. Stipe central to excentric

- A. Pileus red or reddish, scaly
 1. Scales deep red on a yellow ground, scattered.....*B. pictus*
 2. Scales grayish-red to yellowish on a red ground, dense
.....*B. spectabilis*
- B. Pileus white or grayish, slightly squamose.....*B. grisellus*
- C. Pileus dark chestnut to yellowish-brown, subtomentose..*B. castanellus*
- D. Pileus deep red, floccose-tomentose.....*B. paluster*

II. Stipes excentric to lateral

- A. Pileus reddish-brown, nearly glabrous.....*B. porosus*

Key to *Boletus*

I. Pileus white to dull buffy-yellow or light tan or grayish-white to buff-gray

- A. Pileus with floccose-squamose scales; flesh white quickly changing to blue where wounded.....*B. cyanescens*
- B. Pileus not scaly, smooth or tomentose; surface of tubes white at first, later pale yellowish.
 1. Stipe white, marked with dark to whitish scabrous dots..*B. niveus*
 2. Stipe whitish to rosy at apex, chrome yellow below, minutely scabrous.....*B. chromapes*
 3. Stipe white at first, later streaked with grayish-brown, nearly smooth.....*B. pallidus*

II. Pileus definitely yellow to orange

- A. Pileus viscid to glutinous
 - B. Surface of tubes light-yellow at first, later darker
 - C. Stipe with a distinct annulus near apex, dotted with glandules

1. Pileus thick, compact and convex; stipe reticulate at apex, over 1 cm. thick; veil often sheathing stipe.

B. luteus

2. Pileus not thick, flattened; stipe usually less than 1 cm. thick, not reticulate at apex; veil never sheathing stipe. *B. subluteus*

C. Stipe without an annulus

1. Pileus reddish or orange; stipe with yellow reticulated lacerations. *B. Betula*

C. Stipe not reticulated or lacerated, covered with glandular dots that become reddish-brown to blackish; pileus may have scattered fibrils or small squamules

1. Mouth of tubes large; stipe slender. . . . *B. americanus*
2. Mouth of tubes small to medium; stem larger.

B. subareus

3. Stipe dotted with rosy-colored, fibrous warts and flecks; pileus orange-red. *B. rubropunctus*

A. Pileus dry or somewhat viscid when wet

B. Stipe reticulated

- C. Mouth of tubes scarlet before maturity; pileus and stipe chrome yellow. *B. auriflammeus*

III. Pileus some shade of yellowish-brown, olive-brown or olive-gold

A. Pileus viscid to glutinous

- B. Surface of tubes yellowish or straw-colored at first, darker at maturity

- C. Stipe with a distinct annulus near apex. *B. luteus*

- C. Stipe without an annulus, viscid, dotted nearly all over with reddish-brown glutinous droplets. *B. granulatus*

A. Pileus dry or somewhat viscid when wet

- B. Surface of tubes white at first, yellow to buff or olivaceous at maturity

- C. Stipe hollow. *B. castaneus*

C. Stipe not hollow

1. Stipe covered with wide lacerated plates. *B. Russellii*
2. Stipe not lacerated, but reticulated at least at apex; pileus glabrous; tubes tinged greenish, their mouths stuffed at first. *B. edulis*
3. Stipe not lacerated or definitely reticulated, but conspicuously marked with dark, scabrous dots over a whitish or yellowish ground. *B. scaber*
4. Stipe not scabrous; tubes not stuffed at first; pileus nearly glabrous. *B. affinis*

- B. Surface of tubes yellow from the first, greenish-yellow at maturity
 - C. Stipe distinctly reticulated all over
 - 1. Pileus yellow-pulverulent, sometimes rimose-areolate.
B. retipes
 - 2. Pileus not yellow-pulverulent; flesh yellow. *B. ornatipes*
 - C. Stipe not reticulated
 - 1. Pileus felted-tomentose; tubes adnate-depressed, their mouths 1-2 mm. broad. *B. subtommentosus*
 - 2. Pileus glabrous
 - a. Sporophore parasitic on Scleroderma; tubes more or less decurrent. *B. parasiticus*
 - b. Sporophore not parasitic; tubes adnate-depressed. *B. subglabripes*
- B. Surface of tubes white, then rosy to brownish-flesh color.
B. gracilis
- B. Surface of tubes red at first and in age, or becoming yellowish or brownish at maturity
 - C. Stipe reticulated; pileus often bright red. *B. luridus*
 - C. Stipe not reticulated
 - 1. Stipe furfuraceous, yellow above, red below; pileus olive-yellow to brownish tinged reddish. . *B. erythropus*
 - 2. Stipe slender, tawny yellow with bright yellow base; sporophore quite small. *B. piperatus*
- B. Surface of tubes pale ochraceous; stipe light brown, reticulated; pileus minutely tomentose, yellowish-brown. *B. modestus*
- B. Surface of tubes yellowish with reddish-brown mouths; stipe with reddish-brown tomentum at base, yellow at apex; pileus yellowish-brown to reddish-brown; flesh white, both it and tubes changing to blue where wounded. *B. subvelutipes*
- B. Surface of tubes dark brown to blackish-brown at first, becoming brownish-yellow at maturity. *B. vermiculosus*

IV. Pileus rosy, blood-red or purplish-red

- A. Pileus viscid to glutinous; mouths of tubes deep red. *B. Frostii*
- A. Pileus dry or slightly viscid when wet
 - B. Surface of tubes white or nearly so at first, yellowish or flesh color at maturity
 - C. Stipe not reticulated, minutely scabrous, whitish to rosy at apex, bright chrome yellow below. *B. chromapes*
 - C. Stipe not reticulated at least above
 - 1. Pileus tomentose with a bloom; taste bitter; stipe rosy or blood-red with yellow at base and apex.
B. Peckii
 - 2. Pileus glabrous without a bloom; taste mild; stipe whitish or concolorous with pileus. *B. separans*

B. Surface of tubes yellow even at first, dull yellow to olivaceous at maturity

C. Stipe not reticulated; tubes small and quite short

1. Stipe red-velvety nearly all over or only below; flesh not at all or only slightly changing to blue where wounded.....*B. bicolor*

2. Stipe yellow nearly all over and smooth or nearly so; flesh changing to blue where wounded.

B. miniato-olivaceus

C. Stipe small and flexuous, red and yellow, white tomentose at base; pileus red and yellow, minutely subtomentose; tubes lemon-yellow becoming yellow and sometimes with red mouths at maturity.....*B. rubeus*

V. Pileus some shade of red-brown, vinaceus-brown, dull red or orange-red

A. Pileus distinctly viscid to glutinous

B. Surface of tubes bright chrome yellow (pileus often dry to somewhat viscid).....*B. auriporus*

B. Surface of tubes creamy-white to pale yellow at first, yellow to brownish at maturity

C. Stipe distinctly viscid, dotted nearly all over with reddish-brown glutinous droplets.....*B. granulatus*

C. Stipe not viscid

1. Pileus and stipe both tomentose-dotted; stipe pale brownish, often abruptly yellow at apex, streaked with dark lines.....*B. badius*

2. Pileus glabrous; stipe creamy-yellowish, dotted with dry rosy or pale flecks and squamules.*B. rubropunctus*

A. Pileus dry to somewhat viscid when wet

B. Surface of tubes white at first, buff to olivaceous at maturity

C. Stipe distinctly hollow.....*B. castaneus*

C. Stipe covered with lacerated plates which become gelatinous when wet.....*B. russellii*

C. Stipe not lacerated, but distinctly reticulated at least at apex; mouths of tubes distinctly stuffed at first

1. Pileus glabrous; mouths of tubes tinged greenish; white to brownish.....*B. edulis*

2. Mouth of tubes white and not becoming greenish.

B. nobilis

3. Pileus glabrous; stipe rhubarb or lilac-colored.

B. separans

- C. Stipe not lacerated or distinctly reticulated
 - 1. Mouths of tubes slightly stuffed at first; pileus glabrous or nearly so. *B. affinis*
 - 2. Mouths of tubes not stuffed at first, of a gray color; pileus margin appendiculate. *B. versipellis*
- B. Surface of tubes white or nearly so at first, flesh-colored or rosy to brownish at maturity
 - C. Stipe long and slender, brown velvety pruinose; tubes and stipe not turning brown when rubbed. *B. gracilis*
 - C. Stipe short in proportion to width of pileus, reticulated at least at apex; tubes and stipe becoming brown when rubbed. *B. indecisus*
- B. Surface of tubes yellow even at first, more or less olivaceous at maturity
 - C. Stipe not reticulated
 - 1. Stipe conspicuously dotted with brown squamules on a yellow or brownish ground. *B. rimosellus*
 - 2. Stipe with brown punctate scales on a yellow ground, bright yellow inside; flesh and tubes quickly becoming bright blue where wounded. *B. pulverulentus*
 - C. Stipe neither reticulated nor strongly squamulose; pileus submentose to velvety, areolated with reddish cracks; flesh usually changing to blue where wounded. *B. chrysenteron*
 - C. Stipe more or less striate
 - 1. Pileus and stipe leather color with a tinge of red. *B. alutaceus*
 - 2. Pileus chestnut to dark brown; stipe bright yellow at first, tinged reddish brown at maturity. *B. subglabripes*
- B. Surface of tubes dark brown or purplish-brown even at first
 - C. Flesh of tubes yellow becoming blue when wounded; stipe bright or dull yellow, often with dark lines. *B. vermiculosus*
- B. Surface of tubes red to dark red at first and at maturity, or olivaceous-yellow or brownish in age
 - C. Sporophore large, pileus 8-12 (27) cm. broad . . . *B. luridus*
 - C. Sporophore small, pileus 1.5-5.5 cm. broad; flesh of tubes reddish; taste peppery. *B. piperatus*

VI. Pileus medium to dark gray or gray brown

- A. Surface of tubes white, then rosy.....*B. alboater*
- A. Surface of tubes white, then pale gray-clay or pale drab
 - B. Stipe distinctly reticulated.....*B. griseus*
 - B. Stipe not reticulated, but marked with dark scabrous dots over a white or yellowish ground.....*B. scaber*
- A. Surface of tubes deep yellow at first, then duller yellow (dark forms of)
B. retipes

VII. Pileus dark brown to dark olive-brown, purplish-brown to blackish

- A. Pileus distinctly viscid
 - B. Stipe pale brownish, often yellow at apex, streaked with dark lines.....*B. badius*
 - B. Stipe creamy-yellow or brownish-yellow, dotted with dry reddish flecks and squamules.....*B. rubropunctus*
- A. Pileus dry or slightly viscid when wet
 - B. Surface of tubes dark brownish-purple at all stages..*B. eximius*
 - B. Surface of tubes white, then flesh-colored to rosy
 - C. Taste quite bitter; pileus often purplish-brown..*B. felleus*
 - C. Taste mild
 1. Sporophore very dark; pileus, tubes and stipe turning black when injured.....*B. alboater*
 2. Sporophore medium dark; tubes and stipe turning brown when injured.....*B. indecisis*
 - B. Surface of tubes whitish at first, brownish-straw with a reddish tinge at maturity
 - C. Pileus even.....*B. sordidus*
 - C. Pileus reticulate-rimose, often dark olive-brown.
B. fumosipes
 - B. Surface of tubes wood-brown to tawny-olive at first, becoming vandyke-brown at maturity; pileus velvety tomentose, dark olive-brown.....*B. porphyrosporus*

VIII. Pileus violaceus purplish-gray

- A. Surface of tubes white at first, slowly becoming rosy at maturity; stipe slightly violaceous or brownish; pileus glabrous, becoming violaceous-brown in age.....*B. plumbeoviolaceus*

FISTULINACEAE

Key to Fistulina

- I. Pileus livid red to reddish-brown.....*F. hepatica*
- II. Pileus fawn or clay-color.....*F. pallida*

ENUMERATION OF SPECIES

Boletinus castanellus Peck

Armstrong County: Kittanning, 1905 and 1914, D.R.S., the latter determined by W. H. Snell. *Erie County*: Weiss Library Woods, 8 mi. S. W. of Erie, 8/18/31, O.E.J. *Potter County*: 7 mi. N. E. of Austin, 8/15/37, L.K.H., 1465.

Boletinus grisellus Peck

Armstrong County: Kittanning, 1905, D.R.S., determined by W. H. Snell.

Boletinus paluster Peck

Westmoreland County: Forbes Forest, 3 mi. S. E. of Rector, 8/9/41, M.B.K.

Boletinus pictus Peck

Allegheny County: near Wildwood, 8/26/36, D.R.S. *Butler County*: Little Buffalo Creek, near Monroe Station, 9/9/37, L.K.H., 1603. *Centre County*: Alan Seegar Forest, S. E. of Tusseyville, 7/9/37, M.B.K.; Woodward, 7/31/41, D.R.S. *Clarion County*: near Clarion, 9/9/37, D.R.S.; Cook Forest, 10/15/38, D.R.S. *Clearfield County*: along Parker Dam road near Parker Dam, 7/10/40, L.K.H., 3613. *Fayette County*: Ohiopyle, 9/16/06, D.R.S. *McKean County*: near Kane, 7/3/38, D.R.S. *Venango County*: 1 mi. N. E. of Lisbon, 6/26/37, H.S.W.

Boletinus porosus Peck (Plate III, fig. 2)

Allegheny County: Frick Park, Pittsburgh, Oct. 1905, D.R.S.; S. of Stoops Ferry, 7/24/09, O.E.J.; Glenshaw, 8/14/18, O.E.J.; Shields, 9/23/24, Miss Susei; 4 mi. E. of Monongahela, Oct. 1933, C. M. Hepner; Sewickley, 9/3/34, M.B.K.; near Sutersville, 8/17/39, H. Roslund; $\frac{1}{2}$ mi. S. of Smithdale, 6/27/40, L.K.H., 3339; $1\frac{1}{2}$ mi. N.W. of Carnot, 8/14/41, L.K.H., 4868; Bellevue, 8/27/41, J. A. Schatz. *Armstrong County*: Kittanning, July 1902, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, 7/15/39, L.K.H., 4033; near Saxonburg, 9/8/39, D.R.S.; near Portersville, 8/15/40, D.R.S.; near Culmerville, 9/3/40, D.R.S.; near Slippery Rock, 8/21/41, D.R.S.; Stone House, on Route 8 about 2 mi. S. of Muddy Creek Crossing, 8/27/42, D.R.S. *Cambria County*: Cresson, 7/25/09, D.R.S.; Ebensburg, Aug. 1916, D.R.S. *Centre County*: Woodward, 9/7/39, D.R.S. *Clarion County*: Cook Forest, 10/17/26, O.E.J. *Clearfield County*: Little Medix Creek, 1 mi. N. of Caledonia Pike, 7/10/40, L.K.H., 3569. *Crawford County*: Exposition Park, 7/15/08, D.R.S.; French Creek near Cochranon, 8/29/35,

H.S.W. *Elk County*: S. of Kane, 7/4/39, D.R.S.; near Kane, 8/19/42, D.R.S. *Erie County*: Corry, 7/1/08, D.R.S.; Waldameer Park, Erie, 7/21/27, C. K. Henlen; 6 mi. W. of Erie, 7/25/32, O.E.J. *Indiana County*: along Crooked Creek, 2 mi. above Chambersville, 7/29/41, L.K.H. 4717. *Mercer County*: near Sheakleyville, 9/5/36, M.B.K. *McKean County*: Tionesta Tract near Brookston, 7/25/40, L.K.H. 3725. *Somerset County*: near Jennerstown, 9/5/40, D.R.S. *Venango County*: 1 mi. N.E. of Lisbon, 9/25/37, H.S.W. *Westmoreland County*: New Florence, 7/24/08, D.R.S.; Derry, 7/30/08, D.R.S.; Shades Ravine, 2 mi. E. of Trafford, 8/14/35, H.S.W.; Kiski Campus, near Saltsburg, 9/12/37, D.R.S.; Waterford, 9/1/40, D.R.S.; Idlewild Park, 9/5/40, D.R.S.; Loyalhanna Creek above the Dam, 2 mi. S. of Saltsburg, 9/11/40, L.K.H. 4151.

***Boletinus spectabilis* Peck**

Clarion County: near Clarion, 9/6/37, D.R.S. *Crawford County*: Mud Lake, Hartstown, 9/19/35, L.K.H., 494.

***Boletus affinis* Pk.**

Butler County: Stone House, on Route 8 about 2 mi. S. of Muddy Creek crossing, 8/22/42, D.R.S. *Centre County*: State College, 7/22/37, M.B.K.; Woodward, 7/22/38, D.R.S., determined by W. H. Snell. *Clarion County*: near Clarion, 6/20/40, D.R.S., determined by W. H. Snell. *McKean County*: Tionesta Tract near Brookston, 7/25/40, L.K.H. 3745. *Westmoreland County*: Forbes Forest, 3 mi. S.E. of Rector, 7/18/42, M.B.K.

***Boletus alboater* Schw.**

Armstrong County: Kittanning, August 1903, D.R.S. *Bedford County*: Sulphur Springs, 7/6/41, D.R.S. *Clarion County*: Near Clarion, 8/14/41, D.R.S. *Venango County*: 3 mi. N.E. of Emlenton, 8/3/41, L.K.H. 4786, determined by W. H. Snell. *Westmoreland County*: Kiski Campus near Saltsburg, 9/12/37, D.R.S.

***Boletus alutaceus* Morgan**

Armstrong County: Kittanning, July 1902, D.R.S.

***Boletus americanus* Pk.**

Allegheny County: Wildwood, 8/26/36, D.R.S. *Armstrong County*: Kittanning, Aug. 1903, D.R.S. *Blair County*: Yellow Springs, off Route 30 beyond Altoona, 7/16/40, D.R.S. *Butler County*: 2 mi. S. of Leasuresville, 8/22/42, M.B.K. *Centre County*: Woodward, 7/31/41, D.R.S.; Penn State College, 8/15/42, L.K.H., 5350; Headwaters of Black Moshannon Lake,

8/15/42, L.K.H. 5314. *Clearfield County*: Madera, 8/2/37, H.S.W. *Fayette County*: Ohiopyle, 9/10/05, O.E.J. *Forest County*: Cook Forest, 10/5/38, L.K.H., 2698; 1 mi. N. of Brookston, 7/24/40, L.K.H. 3826. *Indiana County*: Juneau, 8/2/39, H. Roslund. *Somerset County*: Somerset, 8/9/06, D.R.S. *Venango County*: 1 mi. N.E. of Lisbon, 9/8/37, H.S.W.; 3 mi. N.E. of Emlenton, 9/26/42, L.K.H. 5490. *Westmoreland County*: Kiski Campus near Saltsburg, 7/13/40, D.R.S.

***Boletus auriflammeus* B. & C.**

Fayette County: Ohiopyle, 9/16/06, D.R.S.

***Boletus auriporus* Pk.**

Allegheny County: Frick Park, Pittsburgh, 7/21/06, D.R.S.; Guyasuta Hollow near Aspinwall, 7/18/43, F. Napier; North Park, 8/25/44, L.K.H. 5580. *Armstrong County*: Kittanning, 1901, D.R.S. *Butler County*: 1 mi. S.E. of Whitestown, 9/17/40, L.K.H. 4338. *Centre County*: Woodward, 7/31/41, D.R.S., determined by W. H. Snell. *Clarion County*: Cook Forest, June 1927, O.E.J.; near Clarion, 9/16/37, D.R.S.; near Leeper, 8/18/42, D.R.S. *Mercer County*: Sheakleyville, 9/5/36, M.B.K. *Westmoreland County*: Derry, 7/20/08, D.R.S.; near South Greensburg, 7/29/37, L.K.H. 1308; Kiski Campus near Saltsburg, 8/2/37, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 9/18/37, O.E.J.; Shades Ravine, 2 mi. E. of Trafford, 8/10/39, M.B.K.

***Boletus badius* Fr.**

Armstrong County: Kittanning, September 1901, D.R.S. *Clarion County*: Cook Forest, 10/7/38, L.K.H. 2666. *Clearfield County*: near Parker Dam, Lawrence Twp., 7/10/39, L.K.H. 3616. *Venango County*: 1 mi. N.E. of Lisbon, 9/19/36, L.K.H., 814.

***Boletus Betula* Schw.**

Armstrong County: Kittanning, August 1904, D.R.S.

***Boletus bicolor* Peck**

Allegheny County: near Aspinwall, 7/18/43, F. Napier. *Armstrong County*: Kittanning, 1901, D.R.S. *Beaver County*: W. of Aliquippa, off Route 151, 8/8/43, C. Ruprecht. *Butler County*: 4 mi. N.E. of Harmony, 9/13/36, L.K.H. 778, determined by W. H. Snell. *Centre County*: 10 mi. S. of State College, 7/17/36, M.B.K., determined by L. O. Overholts; Woodward, 7/21/41, D.R.S., determined by W. H. Snell. *Clarion County*: Near Clarion, 8/15/41, D.R.S., determined by W. H. Snell. *Indiana*

County: Crooked Creek, 2 mi. above Chambersville, 7/29/41, L.K.H. 4740, determined by W. H. Snell. *Venango County:* 3 mi. N.E. of Emlenton, 8/3/41, L.K.H. 4785, determined by W. H. Snell. *Westmoreland County:* Ligonier, 7/24/07, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 9/11/38, M.B.K.; Waterford, 8/12/42, D.R.S.

***Boletus castaneus* Bull.**

Allegheny County: Frick Park, Pittsburgh, 7/11/06, D.R.S.; Sandy Creek, 7/26/06, D.R.S.; Wildwood, 8/26/36, D.R.S.; North Park, 7/26/41, L.K.H. 4671; 1 mi. N.E. of Ben Avon Heights, 7/31/43, L.K.H. 5123. *Armstrong County:* Kittanning, 1901, D.R.S. *Beaver County:* Raccoon Creek, 2½ miles S.E. of New Sheffield, 7/21/41, L.K.H. 4574. *Butler County:* Little Buffalo Creek at Monroe Station, 9/9/37, L.K.H. 1568; 4 mi. N.E. of Harmony, 9/8/40, L.K.H. 4065; Slippery Rock, 8/21/41, D.R.S. *Cambria County:* Gallitzin, 7/21/07, P. Klingensmith. *Clearfield County:* State Game lands 34, S. of Medix Run, Goshen Twp., 7/10/40, L.K.H. 3554. *Crawford County:* near Cochrannton, 8/27/35, H.S.W. *Fayette County:* Ohiopyle, July 1905, D.R.S. *Indiana County:* Crooked Creek, 2 mi. above Chambersville, 7/29/41, L.K.H. 4725. *Mercer County:* Transfer, 8/9/12, D.R.S. *Somerset County:* Buckstown, 10/2/37, M.B.K. *Venango County:* 3 mi. N.E. of Emlenton, 8/3/41, L.K.H. 4776. *Westmoreland County:* Latrobe, 1905, D.R.S.; Derry, 7/30/08, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 7/28/28, O.E.J.; Pike Run, N.E. of Hopewell, 9/6/36, D.R.S.; near South Greensburg, 7/29/37, L.K.H. 1323; Shades Ravine 2 mi. E. of Trafford, 8/11/37, L.K.H. 1367; near Saltsburg, 8/29/37, D.R.S.

***Boletus chromapes* Frost**

Westmoreland County: Forbes Forest, 3 mi. S.E. of Rector, 9/18/37, M.B.K.

***Boletus chrysenteron* Bull. (Plate II, fig. 3)**

Allegheny County: Frick Park, Pittsburgh, 7/27/07, D.R.S., determined by W. H. Snell; Mt. Lebanon, 9/23/34, H. McCullough; French Creek near Cochrannton, 8/19/35, H.S.W.; North Park, 8/24/35, L.K.H. 390; Schenley Park, Pittsburgh, 6/28/37, D.R.S.; 1 mi. N.E. of Ben Avon Heights, 7/19/37, L.K.H. 1207; along Beaver Grade Road near Montour Run, 7/3/40, L.K.H. 3388; near Imperial, 7/13/39, A. Mielauic; Warden Mine region opposite Sutersville, 8/1/40, H. Roslund; 1 to 2 mi. N.W. of Mt. Nebo, 8/3/40, L.K.H. 3906. *Armstrong County:* Kittanning, August 1902, D.R.S. *Beaver County:* near Aliquippa, 6/20/39, S. Ristich; along

Route 151, $\frac{3}{4}$ mi. from junction with Route 18, 7/10/41, L.K.H. 2671; along Raccoon Creek, $2\frac{1}{2}$ mi. S.E. of New Sheffield, 7/21/41, L.K.H. 4342; near intersection of Beaver-Conway and Ambridge-Rochester Roads, 7/23/41, L.K.H. 4619. *Bedford County*: Sulphur Springs, 7/5/41, D.R.S., determined by W. H. Snell; Bedford Springs, 8/8/40, D.R.S. *Butler County*: Little Buffalo Creek near Monroe Station, 6/23/37, L.K.H. 1058; Watson's Run, 2 mi. S. of Leasuresville, 9/15/37, L.K.H. 1663; 4 mi. N.E. of Harmony, 8/6/38, L.K.H. 2197; Slippery Rock, 7/3/40, D.R.S.; 1 mi. S. of Whitestown, 9/17/40, L.K.H. 4302; Stone House, on Route 8 about 2 mi. S. of Muddy Creek crossing, 8/27/42, D.R.S. *Cambria County*: near Armaugh, 6/27/39, D.R.S. *Centre County*: near State College, 7/18/37, M.B.K.; Woodward, 7/8/39, D.R.S.; Whipple Dam, 7/25/40, M.B.K. *Clarion County*: near Clarion, 9/6/37, D.R.S.; Cook Forest, 9/18/40, D.R.S. *Elk County*: Allegheny National Forest, at junction of Millstone Creek and Clarion River, 7/14/35, H.S.W. *Fayette County*: Ohiopyle, 8/12/08, D.R.S. *Forest County*: Tidioute, 7/13/42, D.R.S. *McKean County*: Tionesta Tract near Brookston, 7/25/40, L.K.H. *Somerset County*: St. Claris, 7/8/06, D.R.S.; Cranberry Bog on Glade Run, 7 mi. N.E. of Ohiopyle, 6/28/42, O.E.J. *Venango County*: 1 mi. N.E. of Lisbon, 6/26/37, L.K.H. 1058; 3 mi. N. of Emlenton at Goeries Mills, 9/14/40, M.B.K.; near Emlenton, 8/6/42, M.B.K. *Washington County*: vicinity of Hanlin Station, 9/13/40, L.K.H. 4219; 2 mi. above Murdocksville, 8/25/42, L.K.H. 5377; Distillery Stop near New Eagle, 7/9/42, L.K.H. 5180. *Westmoreland County*: Derry, 7/30/08, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 7/22/23, O.E.J.; Shades Ravine, 2 mi. E. of Trafford, 8/14/35, H.S.W.; near South Greensburg, 6/21/37, L.K.H. 1301; Loyalhanna Creek, 2 mi. S. of Saltsburg, 9/11/40, L.K.H. 4147; Kiski Campus near Saltsburg, 9/13/40, D.R.S.; Waterford, 7/15/42, D.R.S.; Jones' Mills, 8/4/44, D.R.S.

***Boletus cyanescens* Bull.**

Allegheny County: Sandy Creek, 8/25/35, L.K.H. 431. *Jefferson County*: between Sigel and Cook Forest, 7/17/35, H.S.W.

***Boletus edulis* Bull. (Plate I, fig. 1)**

Allegheny County: Tarentum, 8/30/26, G. L. Richardson; North Park, 7/26/41, L.K.H. 4679. *Armstrong County*: Kittanning, September 1903, D.R.S. *Bedford County*: Sulphur Springs, 7/5/41, D.R.S. *Butler County*: Little Buffalo Creek near Monroe Station, 9/9/37, L.K.H. 1566; Watson's Run, 2 mi. S. of Leasuresville, 9/15/37, L.K.H. 1618. *Centre County*: State College, 7/24/37, M.B.K.; Woodward, 7/30/41, D.R.S., determined by

W. H. Snell. *Elk County*: Allegheny National Forest at junction of Millstone Creek and Clarion River, 7/14/35, H.S.W. *Forest County*: 1 mi. N.W. of Brookston, 7/24/40, L.K.H. 3828. *McKean County*: Tionesta Tract near Brookston, 7/23/40, L.K.H. 3731. *Somerset County*: 3 mi. W. of Bakersville, 9/12/33, C. M. Hepner; near Buckstown, 9/25/37, O.E.J. *Washington County*: Raccoon Creek below Burgettstown, 8/10/19, O.E.J. *Westmoreland County*: Latrobe, June 1905, D.R.S.; Kiski Campus near Saltsburg, 7/12/40, D.R.S.

***Boletus eximius* Peck**

Clarion County: Cook Forest, 8/9/45, D.R.S.

***Boletus erythropus* Fr.**

Armstrong County: Kittanning, August 1901, D.R.S. *Butler County*: Saxonburg, 6/19/42, D.R.S. *Clarion County*: Cook Forest, 9/18/40, D.R.S., determined by W. H. Snell. *Westmoreland County*: Kiski Campus near Saltsburg, 7/13/40, D.R.S.

***Boletus felleus* Bull. (Plate III, fig. 1)**

Allegheny County: Frick Park, Pittsburgh, August 1906, D.R.S.; 4 mi. E. of Monongahela, 8/15/33, C. M. Hepner; North Park, 8/24/35, L.K.H. 423; Allison Park, 9/19/37, D.R.S.; $\frac{1}{2}$ mi. S.E. of Wildwood, 6/25/38, L.K.H. 1852; Gourdhead Run, N. of Allison Park, 7/4/40, M.B.K.; $\frac{1}{2}$ mi. N.W. of Mt. Nebo, 8/3/40, L.K.H. 3907; 1 mi. N.E. of Ben Avon Heights, 7/31/43, L.K.H. 5141. *Armstrong County*: Kittanning, July 1902, D.R.S. *Beaver County*: near Aliquippa, 6/30/38, L.K.H. 1901, near intersection of Beaver-Conway and Ambridge-Rochester Roads, 7/23/41, L.K.H. 4593. *Bedford County*: Sulphur Springs, 7/5/41, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, July 1934, L.K.H. 96; Little Buffalo Creek near Monroe Station, 9/26/36, L.K.H. 863; Crab Run 4 mi. N.E. of Harmony, 9/18/40, L.K.H. 4370; near Slippery Rock, 8/21/41, D.R.S. *Centre County*: Whipple Dam, 7/28/37, M.B.K.; Rebersburg, 9/10/39, D.R.S. *Clarion County*: near Clarion, 6/20/40, D.R.S.; Cook Forest, 7/20/40, D.R.S. *Clearfield County*: State Game Refuge 34, S. of Medix Run, Goshen Twp., 7/9/40, L.K.H. 3488. *Crawford County*: French Creek near Cochranston, 8/29/35, H.S.W. *Elk County*: Allegheny National Forest at junction of Millstone Creek and Clarion River, 7/19/35, H.S.W. *Erie County*: Corry, 7/1/08, D.R.S.; Presque Isle, 1934, O.E.J. *Fayette County*: Ohiopyle, 8/8/01, D.R.S. *Forest County*: 1 mi. N.W. of Brookston, 7/24/40, L.K.H. 3811. *Indiana County*: near Glenn Campbell, 8/4/38, L.K.H. 2105; Crooked Creek, 2 mi.

above Chambersville, 7/29/41, L.K.H. 4739. *Mercer County*: Houston Junction, 7/12/02, J. A. Shafer, Transfer, 8/9/12, D.R.S. *McKean County*: near Kane, 7/3/38, D.R.S. *Venango County*: 1 mi. N.E. of Lisbon, 9/19/36, L.K.H. 819; Cherry Run, 7/15/40, A. G. Shields; along Route 38 S. of Emlenton, 7/16/40, M.B.K.; 1 mi. N.E. of Emlenton, 7/3/42, M.B.K. *Westmoreland County*: Latrobe, June 1905, D.R.S.; 2 mi. S.E. of Laughlintown, 8/26/34, M.B.K.; Shades Ravine, 2 mi. E. of Trafford, 8/28/34, M.B.K.; near South Greensburg, 6/21/37, L.K.H. 896; 1½ mi. E. of New Alexandria, 7/29/37, L.K.H. 1284; Waterford, 8/13/42, D.R.S.

***Boletus Frostii* Russell (Plate I, fig. 2)**

Armstrong County: Kittanning, July 1902, D.R.S. *Crawford County*: French Creek, near Cochran, 8/19/35, H.S.W. *Mercer County*: near West Middlesex, 8/23/34, C. M. Hepner. *Westmoreland County*: Waterford, 8/3/42, D.R.S.

***Boletus fumosipes* Pk.**

Allegheny County: Warden Mine region, opposite Sutersville, 7/13/39, H. Roslund; North Park, 7/26/41, L.K.H. 4678, determined by W. H. Snell.

***Boletus glabellus* Pk.**

Armstrong County: Kittanning, July 1901, D.R.S.

***Boletus gracilis* Pk.**

Armstrong County: Kittanning, 1905, D.R.S. *Butler County*: Little Buffalo Creek near Monroe Station, 9/9/37, L.K.H. 1605. *Clarion County*: Cook Forest, 10/7/38, L.K.H. 2619. *Fayette County*: Ohiopyle, 7/16/06, D.R.S.

***Boletus granulatus* L.**

Armstrong County: Kittanning, 1905, D.R.S. *Bedford County*: Sulphur Springs, 9/29/40, M.B.K. *Butler County*: 2 mi. S. of Leasuresville, 10/26/41, M.B.K. *Centre County*: Musser's Gap near State College, 6/30/36, M.B.K.; Alan Seegar Forest, S.E. of Tusseyville, 7/30/37, M.B.K.; Rebersburg, 9/10/39, D.R.S.; near Port Matilda, 7/11/40, L.K.H. 3668. *Clarion County*: near Clarion 6/20/40, D.R.S., determined by W. H. Snell. *Fayette County*: Ohiopyle, 8/7/07, D.R.S. *McKean County*: near Kane, 7/2/38, D.R.S. *Somerset County*: near Lambertsville, 10/2/38, O.E.J. *Venango County*: 1 mi. N.E. of Lisbon, 9/25/37, H.S.W.; 3 mi. N. of Emlenton, 9/14/40, M.B.K. *Westmoreland County*: Derry, 8/6/06, D.R.S.; near New Florence, 8/7/38, O.E.J.; Kiski Campus near Saltsburg, 9/13/40, D.R.S.

Boletus griseus Frost

Butler County: Slippery Rock, 8/21/41, D.R.S., determined by W. H. Snell; Stone House on Route 8 about 2 mi. S. of Muddy Creek crossing, 8/27/42, D.R.S. *Centre County*: Alan Seegar Forest, S.E. of Tusseyville, 7/14/37, M.B.K.; Woodward, 7/30/41, D.R.S., determined by W. H. Snell. *Clarion County*: near Clarion, 8/14/41, D.R.S., determined by W. H. Snell; Cook Forest, 8/14/41, D.R.S. *Forest County*: western part of Allegheny National Forest, 8/6/42, M.B.K. *Mercer County*: Sandy Lake, 6/30/35, L.K.H. 298. *Venango County*: 1 mi. N.E. of Lisbon, 9/7/36, H.S.W. *Westmoreland County*: near Rachelwood, 6 mi. S. of New Florence, 7/15/42, L.K.H. 5244.

Boletus hemichrysus B. & C.

Centre County: Woodward, 8/6/41, D.R.S.

Boletus indecisis Pk.

Armstrong County: Kittanning, 1901, D.R.S.; near Ford City, 7/10/39, D.R.S. *Beaver County*: Raccoon Creek, 2½ mi. S.E. of New Sheffield, 7/21/41, L.K.H. 4223. *Butler County*: Little Buffalo Creek near Monroe Station, 9/9/37, L.K.H. 1578; Watson's Run, 2 mi. S. of Leasuresville, 9/15/37, L.K.H. 1651; 4 mi. N.E. of Harmony, 7/13/41, L.K.H. 4174. *Centre County*: Woodward, 8/4/41, D.R.S., determined by W. H. Snell. *Erie County*: Presque Isle, July 1927, O.E.J. *Jefferson County*: between Sigel and Cook Forest, 7/17/35, H.S.W. *Westmoreland County*: Shades Ravine, 2 mi. E. of Trafford, 8/14/35, H.S.W.; 1½ mi. E. of New Alexandria, 7/29/37, L.K.H. 1290; Kiski Campus near Saltsburg, 9/13/40, D.R.S.; Loyalhanna Gorge, 2 mi. above Kingston, 7/28/41, L.K.H. 4694.

Boletus luridus Schaeff. (Plate II, fig. 4)

Armstrong County: Kittanning, September 1901, D.R.S. *Centre County*: State College, 7/3/42, M.B.K. *Jefferson County*: between Sigel and Cook Forest, 7/17/35, H.S.W. *Mercer County*: near West Middlesex, 8/26/34, C. M. Hepner. *Venango County*: 1 mi. N.E. of Emlenton, 7/3/42, M.B.K. *Westmoreland County*: Ligonier, 7/28/08, D.R.S.; 1 mi. S.E. of Kregar, 8/1/36, L.K.H. 588; near South Greensburg, 7/29/37, L.K.H. 1302; 1½ mi. E. of New Alexandria, 7/29/37, L.K.H. 1281.

Boletus luteus L. (Plate I, fig. 3)

Erie County: Mercyhurst, S. of Erie, October 1931, Sister Mary P. Wilbert.

Boletus miniato-olivaceus Frost.

Allegheny County: near Carnegie Library, Pittsburgh, August 1903, Grace Kinzer; Frick Park, Pittsburgh, 7/6/06, D.R.S. *Armstrong County*: Kittanning, 1901, D.R.S. *Westmoreland County*: Ligonier, 7/28/08, D.R.S.; Derry, 7/30/08, D.R.S.; Kiski Campus, near Saltsburg, 8/29/37, D.R.S.

Boletus modestus Pk.

Armstrong County: Kittanning, 1905, D.R.S. *Westmoreland County*: Derry, 7/9/06, D.R.S.

Boletus niveus Fr.

Butler County: 4 mi. N.E. of Harmony, September 1931, L.K.H. 88. *Centre County*: Woodward, 7/20/41, D.R.S. *Forest County*: 1 mi. N.W. of Brookston, 7/24/40, L.K.H. 3745. *Somerset County*: top of Laurel Hill on Route 30, 8/10/39, D.R.S., determined by W. H. Snell. *Westmoreland County*: Forbes Forest, 3 mi. S.E. of Rector, 9/18/37, M.B.K.; Waterford, 8/12/42, D.R.S.

Boletus nobilis Pk.

Westmoreland County: Derry, 8/6/06, D.R.S.

Boletus ornatipes Pk.

Armstrong County: Kittanning, 1905, D.R.S. *Centre County*: Woodward, 7/31/41, D.R.S. *Fayette County*: Ohiopyle, 8/13/08, D.R.S. *Venango County*: 3 mi. N.E. of Emlenton, 8/3/41, L.K.H. 4784, determined by W. H. Snell. *Westmoreland County*: 1 mi. S.E. of Kregar, 8/1/36, L.K.H. 591; near South Greensburg, 7/29/37, L.K.H. 1303.

Boletus pallidus Frost

Allegheny County: North Park, 7/26/41, L.K.H. 4673. *Armstrong County*: Kittanning, August 1904, D.R.S. *Beaver County*: near Aliquippa, 7/13/39, L.K.H. 2909. *Butler County*: near Slippery Rock, 8/21/41, D.R.S., determined by W. H. Snell; 4 mi. N.E. of Harmony, 9/18/40, L.K.H. 4368; Watson's Run, 2 mi. S. of Leasuresville, 8/22/42, M.B.K. *Centre County*: Woodward, 7/31/41, D.R.S., determined by W. H. Snell; 8 mi. N.W. of State College, 8/15/42, L.K.H. 5281. *Clarion County*: Cook Forest, 8/23/39, M.B.K.; near Clarion, 8/14/41, D.R.S.; near Leeper, 8/18/42, D.R.S. *Crawford County*: French Creek near Cochrannton, 8/19/35, H.S.W. *Elk County*: S. of Kane, 7/4/39, D.R.S. *Venango County*: near Emlenton, 8/6/42, M.B.K. *Westmoreland County*: Ligonier, 7/28/08, D.R.S.; Shades Ravine, 2 mi. E. of Trafford, 8/14/35, H.S.W.; 6 mi. S. of New Florence,

8/7/38, O.E.J.; 4 mi. E. of Delmont, 7/29/41, L.K.H. 4751; Forbes Forest, 3 mi. S.E. of Rector, 8/9/41, M.B.K.; Kiski Campus near Saltsburg, 9/13/41, D.R.S., determined by W. H. Snell; Waterford, 8/13/42, D.R.S.

Boletus parasiticus Bull.

Allegheny County: Sandy Creek, 7/26/06, D.R.S.; Schenley Park, Pittsburgh, 7/29/40, D.R.S. *Armstrong County*: Kittanning, July 1902, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, 9/18/40, L.K.H. 4397. *Cambria County*: Cresson, 8/1/06, D.R.S. *Centre County*: Woodward, 8/5/41, D.R.S. *Elk County*: near Kane, 8/14/42, D.R.S. *Fayette County*: Ohiopyle, 8/21/08, D.R.S.; near Normalville, 8/20/40, D.R.S. *Westmoreland County*: Derry, 7/30/08, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 8/27/28, O.E.J.; Shades Ravine, 2 mi E. of Trafford, 8/11/37, L.K.H. 1357.

Boletus Peckii Frost

Clarion County: Cook Forest, 8/9/45, D.R.S.

Boletus piperatus Bull.

Armstrong County: Kittanning, August 1904, D.R.S.

Boletus plumbeoviolaceus Snell & Dick

Westmoreland County: Kiski Campus, near Saltsburg, 9/13/40, D.R.S., determined by W. H. Snell.

Boletus porphyrosporus Pk.

Armstrong County: near Kittanning, 7/21/28, Amy Neale, determined by W. H. Snell.

Boletus pulverulentus Opat.

Allegheny County: Frick Park, Pittsburgh, 7/6/06, D.R.S.; 1 mi. N.E. of Ben Avon Heights, 7/19/37, L.K.H. 1186; Warden Mine region opposite Sutersville, 8/11/39, H. Roslund; near Sewickley, 8/25/39, D.R.S.; ½ mi. S. of Smithdale, 6/27/40, L.K.H. 3360; ½ mi. N.E. of Mt. Nebo, 8/3/40, L.K.H. 3908. *Beaver County*: Raccoon Creek, 2½ mi. S.E. of New Sheffield, 7/21/41, L.K.H. 1825; woods near intersection of Beaver-Conway and Ambridge-Rochester roads, 7/31/42, L.K.H. 5270. *Butler County*: near Saxonburg, 8/24/36, D.R.S.; 2 mi. S. of Leasuresville, 9/15/37, L.K.H. 1617; 4 mi. N.E. of Harmony, 7/3/39, L.K.H. 2820; near Butler, 8/21/39, D.R.S. *Washington County*: Raccoon Creek, 2 mi. above Murdocksville, 8/25/42, L.K.H. 5387.

Boletus retipes B. & C.

Crawford County: French Creek near Cochranston, 9/19/35, D.R.S.

Boletus rimosellus Pk.

Armstrong County: Kittanning, August 1902, D.R.S. *Crawford County:* French Creek near Cochran, 8/29/35, H.S.W.

Boletus rubeus Frost

Armstrong County: Kittanning, July 1902, D.R.S., determined by W. H. Snell. *Bedford County:* Sulphur Springs, 7/6/41, D.R.S., determined by W. H. Snell.

Boletus rubropunctus Pk.

Armstrong County: Kittanning, July 1905, D.R.S., determined by W. H. Snell. *Fayette County:* Ohiopyle, 9/16/06, D.R.S.

Boletus russelli Frost

Armstrong County: near Kittanning, 8/16/05, D.R.S.

Boletus scaber Fr. (Plate I, fig. 4)

Allegheny County: Frick Park, Pittsburgh, 10/5/34, L.K.H. 160; near Ingomar, 9/8/40, M. Vetter; 1 mi. out Audubon Road from Magee Road, 9/9/40, L.K.H. 4096. *Armstrong County:* Kittanning, 1901, D.R.S.; Big Buffalo Creek valley near West Winfield, 8/12/39, M.B.K. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Little Buffalo Creek near Monroe Station, 6/23/37, L.K.H. 1038; Watson's Run, 2 mi. S. of Leasurville, 9/15/37, L.K.H. 1642; Connoquenessing Creek 3 mi. N.E. of Harmony 8/4/41, L.K.H. 4837. *Cameron County:* 1 mi. W. of Sinnamahoning, along Route 120, 8/15/37, L.K.H. 1507; 10 mi. N.E. of Sinnamahoning, along Route 872, 8/15/37, L.K.H. 1475. *Centre County:* Woodward, 7/6/39, D.R.S. *Clarion County:* near Clarion, 8/14/41, D.R.S. *Clearfield County:* near Parker Dam, Lawrence Twp., 7/10/40, L.K.H. 3617. *Fayette County:* Ohiopyle, 9/16/06, D.R.S. *McKean County:* Kane, 9/5/37, D.R.S.; Tionesta Tract near Brookston, 7/25/40, L.K.H. 3730. *Somerset County:* ½ mi. N.E. of Pleasant Union, 9/7/36, A. Avinoff. *Venango County:* 1 mi. N.E. of Lisbon, 9/17/36, H.S.W.; 3 mi. N. of Emlenton, 9/14/40, M.B.K. *Westmoreland County:* near Ligonier, 7/28/08, D.R.S.; Shades Ravine, 2 mi. E. of Trafford, 8/14/35, H.S.W.; near South Greensburg, 7/29/37, L.K.H. 1304.

Boletus separans Pk.

Allegheny County: near Imperial, 7/13/39, A. Miclaucic. *Armstrong County:* Kittanning, 1904, D.R.S. *Butler County:* 3 mi. N.E. of Harmony, 8/4/41, L.K.H. 4837. *Clarion County:* near Clarion, 6/20/40, D.R.S., determined by W. H. Snell. *Westmoreland County:* Derry, 7/9/06, D.R.S.

Boletus sordidus Frost

Armstrong County: Kittanning, July 1901, D.R.S.

Boletus subaureus Pk.

Allegheny County: Ingomar, 9/1/36, M.B.K. *Clarion County*: near Clarion, 8/24/41, D.R.S., determined by W. H. Snell.

Boletus subglabripes Pk.

Centre County: State College, 7/24/37, M.B.K. *Westmoreland County*: near South Greensburg, 6/21/37, L.K.H. 1264.

Boletus subluteus Pk.

Allegheny County: near Wildwood, 8/26/36, D.R.S. *Somerset County*: ½ mi. N.E. of Pleasant Union, 9/7/42, A. Avinoff. *Westmoreland County*: Kiski Campus near Saltsburg, 9/13/40, D.R.S., determined by W. H. Snell.

Boletus subtomentosus L.

Allegheny County: near Carnot, 8/20/02, J. A. Shafer; Pine Creek, ½ mi. S.E. of Wildwood, 6/25/38, L.K.H. 1850. *Armstrong County*: Kittanning, July 1902, D.R.S. *Butler County*: Little Buffalo Creek near Monroe Station, 6/23/37, L.K.H. 1263; 4 mi. N.E. of Harmony, 8/6/38, L.K.H. 2193. *Cambria County*: Reel's Corners, 8/9/40, D.R.S. *Centre County*: Woodward, 7/25/40, D.R.S., determined by W. H. Snell; near Port Matilda, 7/11/40, L.K.H. 3694; 8 mi. N.W. of State College, 8/15/42, L.K.H. 5291. *Clarion County*: near Clarion, 9/6/37, D.R.S.; Cook Forest, 7/18/40, D.R.S., determined by W. H. Snell. *Clearfield County*: near Parker Dam, Lawrence Twp., 7/10/40, L.K.H. 3612; Little Medix Creek, 1 mi. N. of Caledonia Pike, Lawrence Twp., 7/10/40, L.K.H. 3581. *Fayette County*: Ohiopyle, 6/17/39, O.E.J. *Forest County*: 1 mi. N.W. of Brookston, 7/25/40, L.K.H. 3794. *Mercer County*: near West Middlesex, 8/24/34, C. M. Hepner. *McKean County*: Tionesta Tract near Brookston, 7/25/40, L.K.H. 3721. *Somerset County*: near Buckstown, 9/25/37, O.E.J.; Kooser State Park, 8/7/44, D.R.S. *Venango County*: 3 mi. N. of Emlenton, 9/14/40, M.B.K. *Washington County*: Distillery Stop at New Eagle, 7/9/42, L.K.H. 5181. *Westmoreland County*: Loyalhanna Creek above the Dam, 2 mi. S. of Saltsburg, 6/12/40, L.K.H. 3110; Forbes Forest, 3 mi. S.E. of Rector, 7/21/40, M.B.K.; 6 mi. S. of New Florence, 7/15/42, L.K.H. 5228.

Boletus subvelutipes Pk.

Armstrong County: Kittanning, 1905, D.R.S., determined by W. H. Snell. *Butler County*: Little Buffalo Creek, near Monroe Station, 7/11/39,

L.K.H. 2852; near Slippery Rock, 8/21/41, D.R.S. *Clarion County*: Cook Forest, 8/14/41, D.R.S., determined by W. H. Snell.

***Boletus vermiculosus* Pk.**

Armstrong County: Kittanning, 1905, D.R.S. *Beaver County*: Raccoon Creek, 2½ mi. S.E. of New Sheffield, 7/21/41, L.K.H. 4590. *Westmoreland County*: Shades Ravine, 2 mi. E. of Trafford, 8/10/39, M.B.K.

***Boletus versipellis* Fr.**

Clarion County: near Clarion, 8/14/41, D.R.S., determined by W. H. Snell.

***Strobilomyces strobilaceus* Bull. (Plate II, fig. 1)**

Allegheny County: Frick Park, Pittsburgh, September 1901, D.R.S.; Power's Run opposite Verona, 1904, O.E.J.; North Park, 8/24/35, L.K.H. 286; 1 mi. N.E. of Ben Avon Heights, 7/19/37, L.K.H. 1190; Warden Mine region opposite Sutersville, 8/1/40, H. Roslund. *Armstrong County*: Kittanning, July 1901, D.R.S.; Big Buffalo Creek across from West Winfield, 8/12/37, M.B.K. *Beaver County*: ½ mi. E. of Raccoon Creek Bridge on Route 30, 8/7/39, A. Miclaucic; near intersection of Beaver-Conway and Ambridge-Rochester Roads, 7/23/41, L.K.H. 4621. *Bedford County*: Sulphur Springs, 7/5/41, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, 8/18/34, L.K.H. 381; near Slippery Rock, 8/21/41, D.R.S.; Stone House on Route 8 about 2 mi. S. of Muddy Creek Crossing, 8/27/42, D.R.S. *Centre County*: Woodward, 7/30/41, D.R.S. *Clarion County*: near Clarion, 9/6/37, D.R.S. *Crawford County*: French Creek near Cochrannton, 8/19/35, H.S.W. *Elk County*: Route 55, 2 mi. S. of Medix Run, 8/15/37, L.K.H. 1520; near Kane, 8/19/42, D.R.S. *Erie County*: Waldameer Park, Erie, 7/24/28, C. K. Henlen; Presque Isle, 7/12/28, O.E.J. *Fayette County*: Ohiopyle, 8/7/07, D.R.S.; Killarny Park near Normalville, July 1919, D.R.S.; near New Geneva, 9/4/38, D.R.S. *Forest County*: Western part of Allegheny National Forest, 8/6/42, M.B.K. *Indiana County*: near Glen Campbell, 8/4/38, L.K.H. 2138; Crooked Creek, 2 mi. above Chambersville, 7/29/41, L.K.H. 4726. *Mercer County*: Transfer, 8/9/12, D.R.S. *Venango County*: 3 mi. N.E. of Emlenton, 8/3/41, L.K.H. 4758. *Westmoreland County*: Derry, 8/6/06, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, 8/28/27, O.E.J.; Forbes Forest, 2 mi. S.E. of Laughlintown, 8/26/34, M.B.K.; Congruity on Route 30, 4 mi. E. of Delmont, 9/27/34, L.K.H. 137; 1½ mi. E. of New Alexandria, 7/29/37, L.K.H. 1285; Kiski Campus near Saltsburg, 7/12/39, D.R.S.; Loyalhanna Gorge, 2 mi. above Kingston,

7/28/41, L.K.H. 4726; Laurel Hill, 6 mi. S. of New Florence, 7/15/42, L.K.H. 5250.

Fistulina hepatica Fr. (Plate II, fig. 2)

Allegheny County: Power's Run opposite Verona, July 1905, Grace Kinzer; Sandy Creek, 8/24/06, D.R.S.; near Stoops Ferry, 7/24/09, O.E.J.; North Park, 8/24/35, L.K.H. 420; near Wildwood, 8/20/36, D.R.S. *Armstrong County*: Kittanning, 1901, D.R.S. *Beaver County*: Beaver Falls, 9/1/34, F. Yetter; Raccoon Creek, 2½ mi. S.E. of New Sheffield, 7/21/41, L.K.H. 3566. *Bedford County*: near Reel's Corners, 8/9/40, D.R.S. *Centre County*: Alan Seegar region, S.E. of Tusseyville, 8/2/36, M.B.K.; near State College, 7/24/37, D.R.S.; Woodward, 9/7/39, D.R.S.; State College Campus, 8/15/42, L.K.H. 5333. *Butler County*: 4 mi. N.E. of Harmony, 8/18/35, L.K.H. 375. *Clarion County*: near Clarion, 9/6/37, D.R.S.; Cook Forest, 9/18/40, D.R.S.; 2 mi. N.W. of Foxburg, 7/2/42, M.B.K. *Clearfield County*: State Game Lands 34, S. of Medix Run, N.W. Girard Twp., 8/20/41, L.K.H. 4916. *Crawford County*: French Creek near Cochranston, 8/25/35, H.S.W. *Erie County*: Waldameer Park, Erie, 1930, C. K. Henlen. *Fayette County*: Ohioptyle, 1904, D.R.S.; near Normalville, 8/20/40, D.R.S.; Laurel Run valley, S.E. of Haydentown, 8/24/40, O.E.J. *Indiana County*: Homer, September 1909, D.R.S. *Lawrence County*: Rock Point, 7/18/07, D.R.S.; Slippery Rock Creek above Wurtemburg, 10/16/10, O.E.J.; Muddy Creek Falls near junction with Slippery Rock Creek, 10/7/37, L.K.H. 1719. *Somerset County*: near Pickings, 7/8/06, D.R.S.; near Trent, 7/31/32, C. M. Hepner. *Venango County*: 1 mi. N. of Lisbon, 9/19/37, H.S.W. *Westmoreland County*: 6 mi. S. of New Florence, 7/8/07, D.R.S.; near Ligonier, 7/24/07, D.R.S.; Derry, 7/20/08, D.R.S.; near Rector, 8/5/23, O.E.J.; Forbes Forest, 2 mi. S.E. of Laughlintown, 8/26/34, M.B.K.; Jones's Mill, 8/17/35, D.R.S.; Pike's Run, N.E. of Hopewell, 9/5/26, D.R.S.; near Mt. Pleasant, 9/7/41, D.R.S.

Fistulina pallida Berk. & Rav.

Armstrong County: Kittanning, July 1903, D.R.S. *Butler County*: near Saxonburg, 10/16/45, D.R.S.

SUMMARY

A key to the six species of *Boletinus* and to the fifty-three species of *Boletus* has been provided.

With the exception of *Boletinus pictus* and *B. porosus*, the species of *Boletinus* are not well represented in collections from Western Pennsylvania.

Of the total of fifty-three species of *Boletus* listed in this paper, seventeen species were collected at only a single locality, eight species were collected in two different localities, and three species were each collected at three separate localities.

The less common *Fistulina pallida* is represented in one collection from Kittanning.

More collecting, especially in the southeastern and northeastern counties of Western Pennsylvania will undoubtedly alter this picture of the distribution of *Boletes*.

BIBLIOGRAPHY

COKER, W. C. AND BEERS, ALMA H.

The Boletaceae of North Carolina. University of North Carolina Press. Chapel Hill, 1943.

MURRILL, W. A.

Agaricales, Polyporaceae-Agaricaceae. North American Flora, vol. 9. 1907-16.

PECK, C. H.

Boleti of the United States. Bulletin of the New York State Museum, vol. 2, no. 8, September 1889.

SNELL, W. H.

Tentative keys to the Boletaceae of the United States and Canada. Publication No. 1 of The Rhode Island Botanical Club, Providence, R. I., 1936.

EXPLANATION OF PLATE I

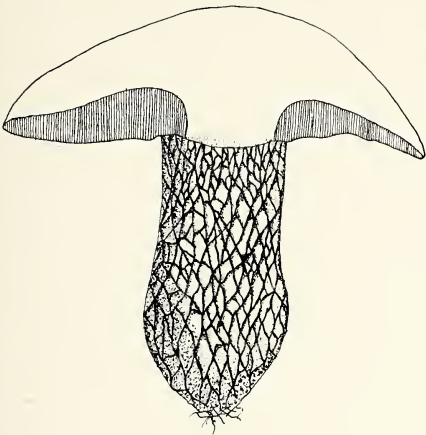
Boletes of Western Pennsylvania.

Fig. 1. Reticulate stipe—*Boletus edulis*.

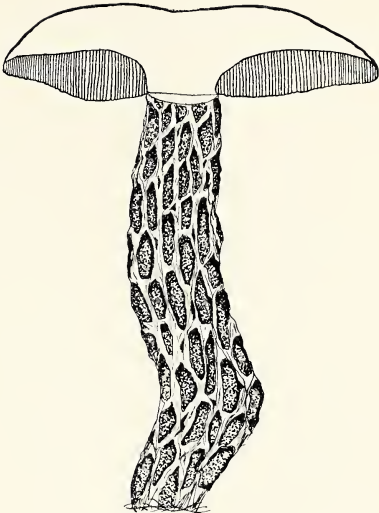
FIG. 2. Lacerate-reticulate stipe—*Boletus Frostii*.

FIG. 3. Annulate stipe; adnate tubes—*Boletus luteus*.

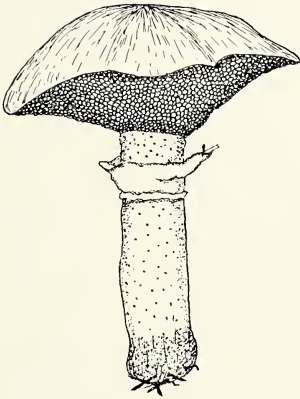
FIG. 4. Scabrous-dotted stipe; free tubes—*Boletus scaber*.



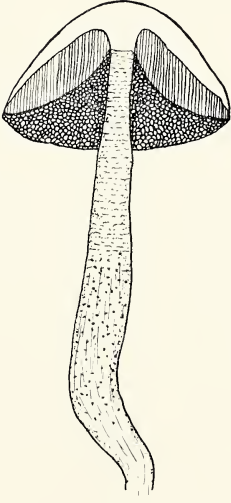
1



2



3

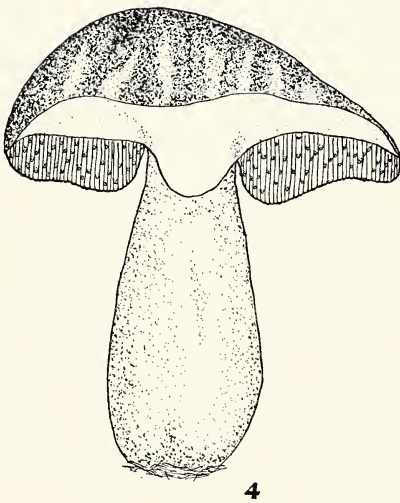
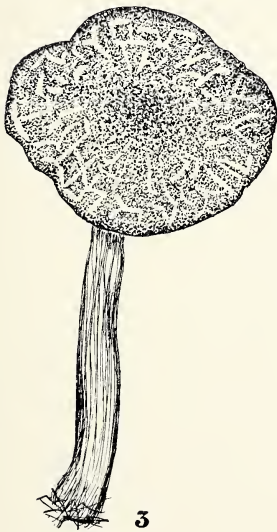
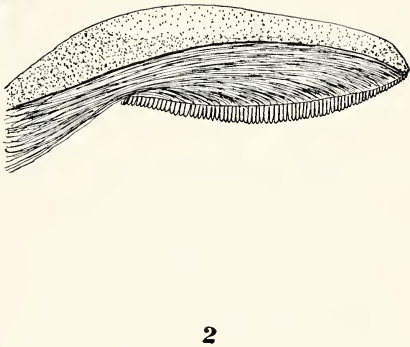


4

EXPLANATION OF PLATE II

Boletes of Western Pennsylvania.

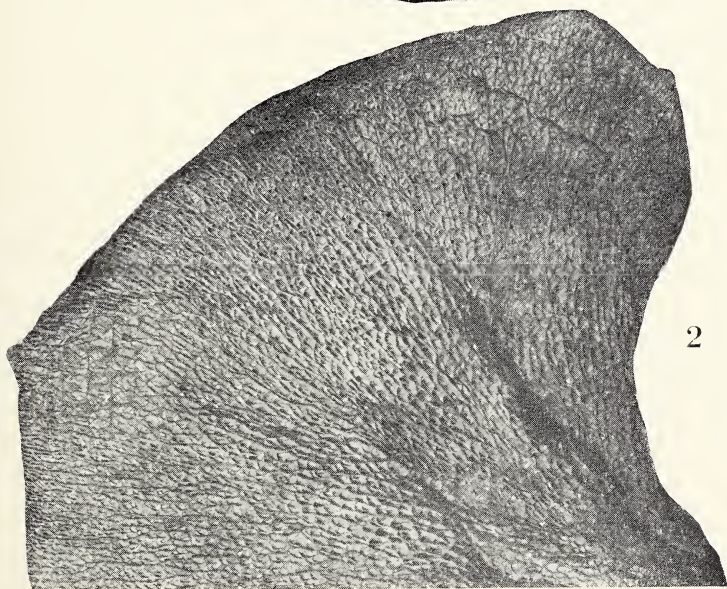
- FIG. 1. Floccose-fibrous warted pileus, floccose-tomentose stipe—*Strobilomyces strobilaceus*.
FIG. 2. Lateral stipe; striated flesh—*Fistulina hepatica*.
FIG. 3. Areolated pileus; fibrous-striate stipe—*Boletus chrysenteron*.
FIG. 4. Smooth stipe; free tubes—*Boletus luridus*.



EXPLANATION OF PLATE III

Boletes of Western Pennsylvania.

FIG. 1. Tubes of a typical *Boletus*—*B. felleus* x 2.FIG. 2. Tubes of a typical *Boletinus*, showing radiating structure—*B. porosus* x $\frac{3}{4}$.



567, 73
24P6842

ART. XIV. LARVAL DEVELOPMENT OF THE EASTERN
NARROW-MOUTHED FROG, *MICROHYLA CAROLINENSIS*
(HOLBROOK), IN LOUISIANA

BY GRACE L. ORTON

(PLATE I)

While engaged in herpetological collecting in the vicinity of Baton Rouge, Louisiana, from May 30 to June 20, 1945, I obtained several series of tadpoles of *Microhyla carolinensis* (Holbrook). These specimens, ranging from early developmental stages to metamorphosing individuals, provide information on a number of features of the larval morphology and development of this frog, and the publication of a separate report on them appears to be warranted.

My work in Louisiana was greatly aided by the privilege of using laboratory facilities in the Department of Zoology of Louisiana State University. For this, and for other kindnesses, I am especially indebted to Prof. William H. Gates, Prof. Ellinor H. Behre, and Dr. Ira D. George.

The first accounts of the life history of *Microhyla carolinensis* appear to be those of Ryder (1891) and Deckert (1914). Both were concerned particularly with the developmental rate, and included little morphological data. The tadpole was first described in detail by Wright (1929). His account was illustrated by a figure of the mouthparts and a small photograph of the tadpole. More descriptive details were included in his later work (1932), with the same figure of the mouthparts and two dorsal-view photographs of the tadpole. His work on this species was based largely on material from the Okefinokee Swamp. Noble (1929) provided a few details on embryonic development, with figures of young embryos and a ventral view of an advanced tadpole. Wright and Wright (1933, 1942) gave a very brief description of the tadpole, and repeated the earlier (1929) illustrations, with one additional lateral-view photograph. Louisiana tadpoles of this frog have not been described previously, the ventral color pattern has not been adequately analyzed and illustrated, nor have the details of spiracle formation been reported. These and other points are treated in the present paper.

The Louisiana specimens upon which this study is based are as follows:

From in or immediate vicinity of Baton Rouge, East Baton Rouge Parish: CM 24213 (55), collected June 5; CM 24214, developmental series from eggs collected June 5; CM 24219 (163), collected June 6;



MAR 25 '46

CM 24267 (4), collected June 11; CM 24313 (1), collected June 16; CM 24358 (4), collected June 19.

From one mile northeast of St. Francisville, West Feliciana Parish: CM 24276 (1), collected June 12.

A series of six early developmental stages (CM 24214) was obtained from eggs collected on the morning of June 5, in shallow water in a marshy area along the lake adjacent to the State Capitol grounds. The eggs were still in a pre-gastrula stage of development when collected, and were presumed to have been laid during the previous night. An unusually large chorus of *Microhyla* had been heard there during the evening. The eggs were small, measuring ± 1.3 mm. in diameter (excluding the jelly), and were in small groups of about twenty to forty, each group in a single layer floating at the surface. The jelly of each egg was distinctly flattened dorsally, as noted by Wright (1932) and others. Although the eggs were sufficiently adhesive to attach to each other under normal conditions in the field (and to collecting instruments), the adhesion was not sufficiently strong to prevent the group from breaking up into individual eggs when handled.

TABLE I

Early Larval Development of *Microhyla carolinensis* (based on CM 24214)

Unit	Time of Preservation	Remarks
a	June 5, 12:30 P.M.	Eggs; pre-gastrula.
b	June 6, 9:30 A.M.	Hatching; total length ± 4 mm. Tail forming, but shorter than body; head structures still very incomplete, gill region swollen but gills not yet formed, paired adhesive organs well developed, mouthparts and eyes not yet externally visible.
c	June 6, 7:00 P.M.	Total length ± 5 mm. Tail well developed; body relatively shorter and thicker, head broader, eyes indicated, external gills well developed, adhesive organs widely separated, mouth better defined but labial structures not yet evident; opercular folds not yet distinct.
d	June 7, 9:00 A.M.	Total length ± 6 mm. Body assuming typical microhylid shape; eyes well developed; opercular folds completed, gills covered; spiracle well developed, in advanced specimens opening about halfway between posterior edge of gill chamber and anus; mouth subtriangular, some trace of lip formation.

- e June 7, 6:30 P.M. Total length $\pm$ 6.5 mm. Body of typical microhylid shape; pigmentation better developed, individual melanophores clearly visible; spiracle opening farther back, nearly in its final position; labial folds quite well developed.
- f June 8, 10:00 P.M. Total length $\pm$ 7.5 mm. Spiracle opening below anus; adhesive organs still evident as pigmented spots, but no longer distinctly projecting.

General information on the developmental series is summarized in Table I. The principal gap in this series is between units *c* and *d*, where the critical early phases in operculum and spiracle formation were missed. In the least advanced specimens in unit *d*, the opercular folds from the two sides have already joined transversely to form a single short median fold. The narrowing of the opening to form the single median spiracle of this species, and its posteriad migration, can be traced in other specimens (Text fig. 1). Migration of the spiracle continues through elongation and

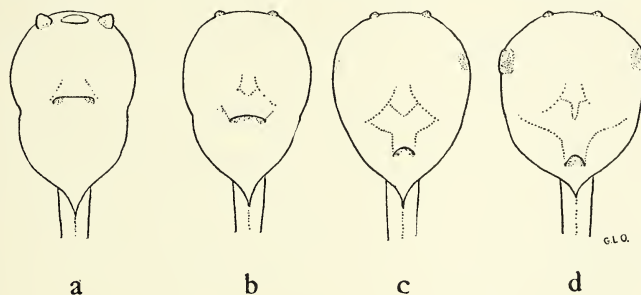


FIG. 1. Four stages in the formation of the spiracle and its posteriad migration in *Microhyla carolinensis*. CM 24214.

enlargement of the gill chamber and spiracular tube until, in tadpoles of about 7.5 mm. in total length, the opening has reached its final position, below and posterior to the anus (Pl. I, fig. 1). By the time this size is attained, the adhesive organs have flattened out, but they persist as pigmented spots until a total length of about 9 mm. is reached.

The developmental rate of the eggs of *Microhyla carolinensis* is probably influenced by temperature to some extent. Ryder (1891) and Deckert (1914), in North Carolina and Florida, respectively, found that the eggs of this frog hatch about three days after they are laid. Wright (1932), working in the Okefinokee, estimated that hatching took place after three days on one occasion; eggs laid a few days later hatched in about a day

and one half. The Louisiana series reported upon in this paper hatched in approximately a day and one half.

The wide range in size of the tadpoles in some of the series collected in Louisiana confirms reports by previous authors that *M. carolinensis* has a prolonged breeding season. The 55 specimens in CM 24213 (taken on June 5, at the same time and place eggs were found) range from 5.5 to 24 mm. in total length, with no sharply defined size groups. It should be pointed out, however, that this particular series is not a random sample of the population, for, after initial sampling, effort was directed toward obtaining the larger tadpoles. Another series, CM 24219 (collected on June 6, in a ditch southwest of the Louisiana State University campus), contains two well defined size groups: 90 larvae, which obviously represent more than one period of breeding, range from 5 to 12.5 mm. in total length (head and body, $\pm 2-6$); and 73 larvae, including two metamorphosing specimens, vary from 27.5 to 34.5 mm. (head and body, 10-12). On June 11, two larvae of 21 and 38 mm., total length, and two transforming specimens were taken; on June 16, a recently-hatched larva of 6 mm. total length was found; and on June 19, larvae of 6.5 to 10.5 mm. in total length were obtained.

By combining the data from the several series of tadpoles, some information on ontogenetic changes becomes apparent and can be summarized. In the material at hand, the hind leg buds become evident as minute, rounded bumps when the tadpole attains a total length of about 8 to 10 mm. These structures increase very slightly in distinctness up to a total length of about 15 to 16 mm., at which time they begin to elongate slightly. In tadpoles of about 19 to 20 mm., the leg buds have enlarged to about 1 mm. in length. At about 21 to 24 mm., the first traces of joint and foot differentiation can be detected, and the leg bud length is about 1.5 mm. Above a total length of 24 mm., leg size increases abruptly, although there is still a general correlation between total length and leg size. In the specimens examined, those under 30 mm. in total length have leg buds of 2.5 to 6.5 mm. in length, and those over 30 mm. have leg buds of from about 5 mm. up to the transformation size of ± 10 mm. Since the snout-vent length of the tadpole at transformation is variable (Wright, 1932), an exact correlation of total length and leg length is not to be expected. It is significant to note that between the time the leg buds reach the readily measurable length of one millimeter and the time of metamorphosis, the total length of the tadpole increases as much as 60 per cent, perhaps much more in some individuals. Some increase in total length apparently continues up to very near metamorphosis.

The development of the striking larval color pattern of *M. carolinensis* can also be traced. The coloration is essentially uniform blackish until a total length of 9 to 11 mm. is reached, when some traces of light ventral spotting become evident in some specimens. The first elements of the pattern to become distinct—and the most constant in occurrence and outline—are two pairs of light spots on the sides, which enlarge and become oblique longitudinal or slightly curved streaks. These lateral spots are usually well defined in 16 mm. larvae, but the ventral pigmentation shows much variation in distinctness. A well defined pattern of ventral spotting is present in most of the larvae over 24 mm. in total length. In 73 larvae having a total length of 27.5 to 34.5 mm. (CM 24219), the skin over the abdomen is opaque and its ground color varies from very dark (blackish in life) to pale bluish-gray, depending upon the state of contraction of the melanophores and probably also upon differences in the actual amount of dark pigment present in individual larvae. Most of the specimens are intermediate between the two color extremes. The bellies of all but about a half-dozen of the tadpoles are quite heavily spotted, and most of the exceptional specimens would be too pale to show pattern elements distinctly. The basic pattern of light spots appears to be as follows: two pairs of oblique longitudinal streaks along the sides; a pair of transverse semicircular spots across the belly; anterior to these a single longitudinal median streak, forked posteriorly; and a pair of short streaks along the base of the spiracular tube, near its opening. In about 15 of the 73 larvae the pattern is very diagrammatic, with all the basic elements sharply defined and not obscured by additional spotting (Pl. I, fig. 3). In the more heavily marked majority, some part of the basic pattern is still, however, usually recognizable (Pl. I, fig. 4).

The development of the mid-lateral light stripe on the side of the tail appears to begin about the same time the ventral spot pattern begins to differentiate. This light stripe is present and conspicuous in all large (over 20 mm. in total length) larvae in the present collection.

Since the differentiation of the color pattern and increase in size continue well after the developing leg buds attain an easily measurable length, it seems apparent that, in this species at least, the term "maturity" as conventionally applied to tadpoles with evident leg buds is a misnomer.

The Carnegie Museum collection includes four tadpoles of *Microhyla carolinensis* from Virginia (CM 19053 and 23784), and two from Florida (CM 8705). They are all of similar size, ranging from 21 to 23.5 mm. in total length (head and body, 7.5-9), with hind leg buds of ± 1 mm. in

length. With respect to extent of leg development, they closely parallel specimens of comparable total length from Louisiana. The ventral color pattern is evident in all, and is especially conspicuous in the two Florida specimens.

To facilitate comparison with specimens from other parts of the range, a detailed description of larval *Microhyla carolinensis* in Louisiana is provided. It is based largely on the series of 73 large larvae included under CM 24219.

Description: (Pl. I, fig. 1). Head and body broad, flattened dorsally, belly moderately deep but not globose. Eyes small, on sides of the broad flat head. External nares not apparent until near metamorphosis, when they open very close together on top of snout. Skin thick and opaque on body and basal third or more of tail. Anus median. Spiracle median, far back, its tubular opening below and slightly posterior to anus. Tail length somewhat variable, usually about 1.5 times head and body length; tail tapers gradually, tip pointed, fins moderately developed, slightly deeper than musculature at point halfway back on tail.

Mouthparts: (Pl. I, fig. 2). Mouth opening small, terminal; upper jaw with a pair of broad rounded lateral flaps overhanging lower jaw and separated medially by a deep concavity; lower jaw with a pair of transverse basal segments joined by a soft outwardly-directed, median loop-like element; a short labial fold along basal segment of jaw, extending from base of median segment back to join lateral base of upper jaw flap; jaw margins soft, no horny beaks, a few specimens with traces of papilla-like processes on margins of upper jaw flaps.

Color (in life): Body dark blackish, dorsal surface very finely stippled with yellow, with no evident pattern; sharp line of demarkation from eye to tip of snout between yellowish above and black of side of head. Upper jaw flaps usually edged with black. Sides darker than dorsum and with less yellow stippling. Skin of belly opaque, its ground color blackish to pale blue-gray; conspicuous lateral and ventral spots very pale orange, dark-edged. Tail musculature black, dorsal edge stippled with yellowish on basal third of tail; a sharply-defined mid-lateral light stripe very prominent on basal third of tail where skin is thick and opaque, much less distinct distally. Tail fins heavily pigmented with black along the half bordering the musculature; marginal half of both upper and lower fins usually unpigmented.

The distinctive pattern and the pale orange color of the ventral spots constitute good field characters for the identification of this tadpole.

The largest specimen in the Okefinokee material reported upon by Wright (1932) had a total length of 26.4 mm. (head and body, 10 mm.). In the Louisiana collection there are 74 tadpoles which exceed this size. They comprise 73 specimens in CM 24219, with total lengths of 27.5 to 34.5 mm. (head and body, 10-12), and one tadpole in CM 24267, with a total length of 38 mm. (head and body, 13.5). The body lengths of transforming specimens were given by Wright as 8.5 to 12 mm. Measurements of the four specimens in metamorphosis obtained at Baton Rouge are:

CM number	Date	Snout-vent length	Total length
24219	June 6	11.5	27.0
24219	June 6	11.5	28.5
24267	June 11	12.5	28.0 (tail beginning to shorten)
24267	June 11	13.0	32.0

In all four of these specimens the front legs are out, and metamorphosis of the head structures has begun. In the absence of data from larger series and from more localities, it is not certain whether the size differences indicated by these measurements of tadpoles and transforming young have a valid geographic basis, or whether they may be correlated mainly with local or seasonal factors.

LITERATURE CITED

DECKERT, RICHARD F.

1914. Further notes on the Salientia of Jacksonville, Fla. Copeia, no. 9: (1-3).

NOBLE, GLADWYN KINGSLEY

1929. The adaptive modifications of the arboreal tadpoles of *Hoplophryne* and the torrent tadpoles of *Staurois*. Bull. Am. Mus. Nat. Hist., 58: 291-334, pls. 15-16, figs. 1-12.

RYDER, J. A.

1891. Notes on the development of *Engystoma*. Amer. Nat., 25: 838-840.

WRIGHT, ALBERT HAZEN

1929. Synopsis and description of North American tadpoles. Proc. U. S. Nat. Mus., 74: 1-70, pls. 1-9.

1932. Life-histories of the frogs of Okefinokee Swamp, Georgia. xvi+497 p., 45 pls. New York: The Macmillan Company.

WRIGHT, ANNA ALLEN, AND ALBERT HAZEN WRIGHT

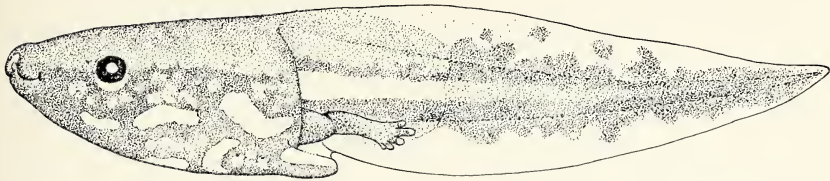
1933. Handbook of frogs and toads. xii+231 p., 81 pls. Ithaca: Comstock Publishing Company.

1942. Handbook of frogs and toads (2nd ed.) xi+286 p., 88 pls. Ithaca: Comstock Publishing Company.

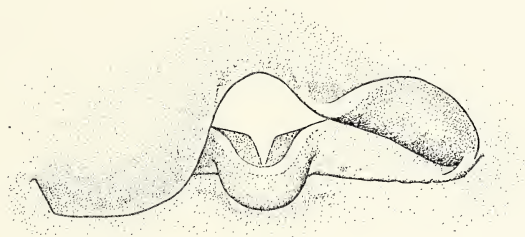
EXPLANATION OF PLATE I

Louisiana tadpoles of *Microhyla carolinensis* (Holbrook).

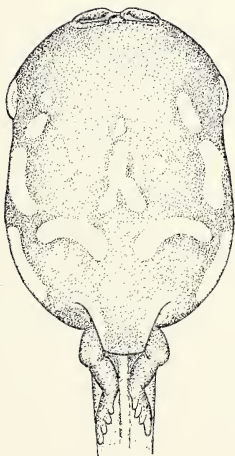
- FIG. 1. Lateral view. Total length, 30 mm. CM 24219.
- FIG. 2. Mouthparts. Lateral flap of upper jaw raised on one side to show labial fold along lower jaw. CM 24219.
- FIGS. 3, 4. Variation in ventral color pattern. Fig. 3 shows basic pattern of ventral spots. Fig. 4 shows an extreme variant. CM 24219.



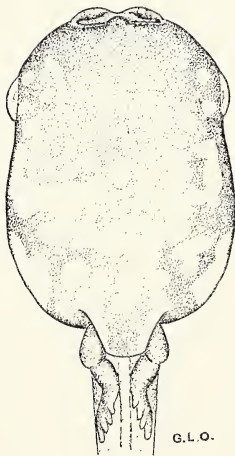
1



2



3



G. L. O.

4

87, 73
4PC842



ART XV. A DISTRIBUTIONAL STUDY OF THE PINE SISKIN

BY DOROTHY MIEROW

MILLS COLLEGE, OAKLAND, CALIFORNIA

INTRODUCTION

For a long time the Pine Siskin has been known to be an erratic wanderer over much of its range. The extent of and the reasons for its wanderings, however, have never been properly investigated. Its erratic behavior as a breeding bird has also attracted notice, but thus far no serious effort has been made to correlate the available nesting records or to learn what pattern, if any, they follow. The primary object of the present study is to determine the normal range of this species and the possible reasons for its movements and its abnormal behavior. By plotting the data on its distribution and abundance on the map, certain facts of interest emerge that have a bearing on the problem.

ORIGIN AND RELATIONSHIPS

The Pine Siskin (*Spinus pinus*) belongs to a group of boreal finches that inhabits the northern evergreen forests. They all show a preference for the seeds of conifers and they are noted for their wanderings.

The genus *Spinus* is widely distributed over the world. There are six species in North America, fifteen in South America, and five in Africa (four in the eastern ranges and one in Cape Colony). In Eurasia, *Spinus spinus* extends from Europe and Asia Minor to eastern Siberia and Japan and south into part of China. Two other species inhabit the Himalayas. Our Pine Siskin is found from Alaska to Labrador and south into Mexico.

A thesis submitted to the University of Pittsburgh in candidacy for the degree of Master of Science.

The author wishes to express her appreciation for information and data received from Mr. Frederick C. Lincoln, of the U. S. Fish and Wildlife Service; from Dr. Arthur A. Allen, of Cornell University; and from Mr. R. J. Niedrach, of the Colorado Museum of Natural History. Mr. W. E. Clyde Todd and Dr. Arthur C. Twomey, of the Carnegie Museum, were consulted throughout the preparation of this thesis. Mr. Todd has made a thorough study of the South American forms of the genus *Spinus* and is responsible for suggesting this investigation.

In considering the origin of the genus *Spinus* it is interesting to find that, of the various species, in *Spinus pinus* the adult plumage is most like that of the immature bird. The plumage is streaked and both sexes are alike. This would indicate that it is the most primitive form of the group and nearest to the "original stock" form from which the others developed. If this is the case, it would seem likely that the species is of Nearctic origin and has spread to the Old World. There are indications that the center of its distribution in America is in the West and that it is extending its range eastward.

During the Pleistocene the life forms of California were much the same as they are today. As now, the state was divided according to climate and altitude into zones of vegetation, each with its characteristic plant and animal life. Below, where Santa Barbara is now, was a Monterey Pine forest with Manzanita underbrush. Here nuthatches, sparrows, wren-tits, red crossbills and Pine Siskins came to feed and here they died—some caught in the tar which bubbled out of the ground in places and thus insured their preservation. By making careful measurements of the bills, these and many other birds have been identified not only in this, the Carpinteria deposit, but also in the deposits of Rancho La Brea, which latter represents a more arid oak and juniper association. Even the fossil records of the Pine Siskin show that it was diversified in its tastes though it kept close to the pines. At this period of glaciation there was a more extensive and continuous coastal pine forest in California than today and consequently the Pine Siskin may have been more numerous, though even now it is by no means uncommon.

GENERAL HABITS

Seemingly almost out of nowhere a flock of siskins appears, circles and settles in a compact group in the top of a spruce tree. They appear to enjoy each other's company and are very active as they methodically pull the seeds from the cones with their sharp little bills, and work their way down the tree. A brief "tsee tsee" and they simultaneously rise in the air and circle again before alighting in the top of another tree. Thus do the Pine Siskins work their way over the extensive coniferous forests of the Canadian and Hudsonian zones. The north woods are fairly humming with their unobtrusive but constant presence. And in this way too or by "flowing" from one tree to another at about the same level, the conifers of the Pacific ranges and the Rocky Mountains are carefully searched, and

the ripe seeds extracted. But the supply of cones is not constant all year round, nor is it even dependable from one year to the next. Consequently they must travel around to find places where food is plentiful and must leave a locality where food is scarce. Like the crossbills, they are irregular in their movements and follow the seed crops. But they are not as dependent on the conifers as the crossbills. They feed their young mainly on aphids and seem quite content with alder, birch, and willow seeds. As they wander farther south and over the plains, their main items of diet may become weed seeds. Farther east, seeds of sweet gum, maple, and elm, as well as buds and insects, form part of their diet. In California, where they seem to be most numerous, they often feed almost entirely on the seeds of eucalyptus, extracting them from the pods either on the trees or on the ground. They also seek after the sweet liquid in the eucalyptus flowers. In British Columbia, in large flocks, they raid vegetable gardens, feeding on the new tender leaves. This undesirable habit fortunately seems to be limited to the Canadian Zone, farmers farther south being undisturbed. A necessary item in the siskin's diet, as well as in that of other boreal finches, is some kind of mineral salt. They have been observed around salt licks and old camp fires frequently. The McCabes, writing from Indianpoint Lake, B. C., told about their destruction of young vegetables. At Barkerville, where siskins appear to be quite numerous, the McCabes found them also attracted to sandy yellow clay, newly-set Portland cement, and deep blue clay from a cellar hole.

In an attempt to follow the Pine Siskins through the seasons, it is found that their irregularities are predictable in certain respects. As fall approaches, there is an extensive migration of individuals from the mountains to the lowlands. Many are found along the roadsides with goldfinches, feeding on sunflower and thistle seeds. They favor the seeds of composites and apparently range over much of the country in their search. In many of the middle western states they pass through regularly enough to be called "spring and fall migrants." But theirs is not a migration like most other birds. They do not gather in flocks from the north and fly to a place in the south to spend the winter and then return north to breed. Instead they are apparently much more interested in the abundance of the food supply than in how advanced the season is, or in getting to a certain place at a certain time. If food is abundant, flocks may remain around one locality all winter with little regard for the cold. Again they may wander widely. As the winter advances and food becomes scarcer, they form larger and larger flocks, and in exceptional years as many as a thousand

have been found as far from their normal breeding range as Kentucky and Alabama. An exceptional crop of cones or other seeds will bring them in large numbers to places where they have not been observed before. As spring comes they reappear in the middle western states. In the West they are seen all the year round, although more often in the valleys and plains during the winter, and mainly in the mountains during the summer. Flocks appear in February or March and large flocks break up into smaller ones. More time is taken in courting performances and less in foraging, and small flocks may break up into pairs. A cold spell causes them to go back to flocking. In ordinary years the siskins do not pass through the central states in very large numbers; they appear to continue either to the Rocky Mountains or to Canada without stopping much along the way. Sometimes, usually after a particularly severe winter and late spring, however, they appear in large numbers and a few pairs remain behind to nest. Many of these sporadic nesting records have been recorded and Prof. Myron H. Swenk of Lincoln, Nebraska, has correlated these records with the temperatures of the months of March, April, and May. He found that if the mean temperatures for April were subnormal they might remain and breed. They might also remain to breed if super-normal April temperatures were followed by subnormal May temperatures. When they did breed, they disappeared soon after the young left the nest and did not reappear until the following fall. Even in places where they have been found to breed more or less regularly, they leave for the higher mountains during July and August. Perhaps it is significant in this connection that most of the breeding records for the East and middle West are in March, April, and May, while those in the mountains and in the north are mainly in June, July, and August. Around Tacoma, Washington, the breeding records range from March to September. Whether the same individuals breed a second time or whether different birds breed at different times has not been determined. Banding returns might solve this problem.

The time required for breeding is, in the case of the Pine Siskin, comparatively short. About a month is all that is necessary, from the time the nest is built until the young can leave the nest and follow after their parents in family groups or join other small flocks. Even during the nesting period the siskin is a very sociable bird. The breeding male may join others to form a flock, and the flock frequently forages in the very tree

which contains the nest. They do not defend a very large territory around the nest and are remarkably unafraid of human intruders. Several pairs have even been found superintending one nest. In general the time spent in nesting is divided in the following ways; about five days in nest building, an incubation period of thirteen days, and fifteen more days after the young birds have hatched before they can leave the nest. The young are fed by regurgitation during the early period, the male feeds the female during incubation and for the first eight days after the eggs have hatched, and she in turn feeds the young. She keeps the nest clean during this period, but lets the outer part become fouled when she joins the male in searching for food in the latter part of the nesting period. Like most small birds, the Siskin is a frequent victim of the Cowbird. A number of the nests discovered contained either an egg or young of this parasite, often to the exclusion of their own young. After leaving the nest, according to observers, the young and old birds form mixed flocks and the siskins continue their wanderings, often some distance away from their nesting sites.

The Pine Siskin has been found in flocks with the several species of Goldfinches, the two species of Crossbills, the Redpoll, the Purple Finch, and the Cedar Waxwing. Some years are marked by exceptional flights of these birds southward. In 1896, enormous flocks were found in Louisiana, South Carolina, Missouri, and Illinois. Again in the year 1907, notable for its cold spring, flocks were observed in Florida, Tennessee, Ohio, Michigan, and Missouri. This year they nested in Nebraska. The season of 1922-3 was characterized by an abundant crop of beech nuts and wild fruits, and again the siskins appeared in large numbers in Alabama, Virginia, Ohio, Wisconsin, North Dakota, and Nebraska. They were conspicuous by their absence from Yosemite National Park, California, in the fall of 1923. In 1925, they were seen in Kentucky and Michigan, and they nested in North Dakota and also at Ithaca, New York. There were abundant spruce, fir, and hemlock seeds in the Great Smokies of Tennessee in 1937. Siskins, usually rare in Tennessee, appeared in thousands during November. In other years, too, there were great flights at one place or another, but in these particular years the movement was most marked. There have been frequent references to the fact that specimens of siskins collected may be in almost any stage of the moult, regardless of the time of year. No doubt this is directly connected with their irregular breeding habits.

SURVEY OF BREEDING RECORDS

In mapping the breeding records and the relative abundance of the Pine Siskin in North America I have discovered the following facts. It is most common in the West and in Canada, but in the East it extends southward from New England along the mountains into North Carolina as a breeding bird. While it has been found breeding in the Great Plains from Oklahoma to North Dakota, these occurrences are sporadic, and it is most common as a regular breeding bird in the coast ranges and the Rocky Mountains. The lack of observers probably accounts for the scarcity of breeding records for the evergreen forests of Canada. It is an irregular winter wanderer over most of eastern and middle western United States and it has been found in all of the southern states and even Cuba at one time or another. Most of the breeding records for the East and middle West are in March, April, and May, those for the North and the mountains are mainly in June, July, and August.

COMPARISON WITH *SPINUS SPINUS*, THE EUROPEAN FORM

Perhaps a clue to their actions may be found in a comparison with those of the European form, *Spinus spinus*, whose habits are remarkably similar. Both are birds of hilly regions and of coniferous forests, yet they often leave these places and wander erratically on the plains in flocks during the winter months. Like our bird, the European Siskin is irregular in its nesting. In Norway it has been found breeding in March or April in seasons when the seeds of *Abies excelsa* were plentiful, and delaying its nesting until May or June when the seed crop was short. They are both friendly birds, and the European form is a popular cage bird, both in Europe and in Japan, where it is also found. Their favorite foods are seeds of pine, birch, and alder, weed seeds, and aphids, though they are by no means limited in their diet. Even their nests and eggs compare closely. Both almost always build in conifers, constructing nests of twigs and rootlets lined with feathers and hair, and lay eggs colored light greenish speckled with a brownish red color. They remain sociable even during the breeding season, and breeding birds join the flocks to feed. Their most striking similarity lies in the fact that they both are erratic wanderers, probably moving mainly according to the food supply, so that at one place they may be either plentiful or scarce at different times.

SUMMARY AND CONCLUSIONS

Siskins are found in both the northern and southern hemispheres over much of the world. The form found in North America is probably the most primitive, as its streaked plumage, alike in both sexes, is most like that of the immature bird. The Pine Siskin's center of distribution is western North America, from which it has probably invaded the East, where it has become noted for its erratic behavior. In the West, during the winter months, Siskins wander in the lowlands, but they return to the mountains in the summer. They are not restricted in their diet, yet they have food preferences which are responsible for their wanderings. Pine Siskins are found in flocks all the year round, often with other species. Their breeding period is comparatively short and does not interfere appreciably with the social habit of flocking. In the West they breed regularly any time from March to September, but breeding in the East is more or less sporadic. Breeding records for the mountains and for Canada are generally later than those for the eastern and middle western states. In some years they appear in large numbers in localities where normally they are scarce. This is caused by an increase in their favorite food supply or by a scarcity of food in other localities rather than by an increase in the actual total number of birds.

1. The normal range of the Pine Siskin is western North America, in the coast ranges and the Rocky Mountains. Here it breeds more or less regularly like other birds and it has an altitudinal migration from the mountains to the valleys in the fall and back to the higher mountains during the summer months.

2. In the East the Pine Siskin is a sporadic wanderer. It is likely to be found almost anywhere where food is plentiful. The usual north and south migration habit of other birds is not followed by the Pine Siskin, as its movements are determined largely by abundance or scarcity of food.

3. If food is abundant and siskins appear in large flocks during the spring months, some may reach the breeding condition while yet outside of their normal breeding range and may remain to breed in other localities. This accounts for the sporadic breeding in the East. The temperatures of the spring months have a definite relationship with the years in which these birds have been found breeding in the middle western states.

BREEDING RECORDS

ARIZONA

Williams. Feeding young late June, 1907. A. Wetmore, Kansas Univ. Sci. Bull., 4, 1908, p. 382.

Mt. Wrightson, east side. Santa Rita Mts. Breeding ♀ May 26, ♂ May 28, nest May 28 with young. G. M. Sutton, Auk, 60, 1943, p. 345.

CALIFORNIA

Santa Clara. Breeding, *ex* J. M. Hyde. J. Van Denburgh, Proc. Amer. Philos. Soc., 38, 1899, p. 171.

Berkeley Campus. Nest discovered in pine, June; many fledglings by Aug. 4, 1912. J. Grinnell, Condor, 16, 1914, p. 34.

Golden Gate Park. Eggs found; March 16, 1916—gathering nest material south of park. M. S. Ray, Condor, 18, 1916, p. 225.

Marin Co. Carrying nesting material. J. Maillard, Condor, 6, 1904, p. 16.

San Mateo Co. Nesting about a mile from San Francisco Bay; over 40 nests, only one not in cypress tree; second week in April to first of July. H. W. Carriger and J. R. Pemberton, Condor, 9, 1907, p. 18.

San Francisco Bay. Many sets of eggs taken with birds adjacent to and a little above tidewater, 1902-05. H. H. Bailey, Wilson Bull., 39, 1931, p. 187.

Santa Cruz Co. June 11, 1902, eggs slightly incubated. H. F. Bailey, Condor, 4, 1902, p. 94.

San Francisco Co. Breeding;—boreal conditions created by planting of trees. H. E. Hansen and W. A. Squires, Condor, 29, 1917, p. 60.

Echo Lake, Eldorado Co. Breeding. D. S. DeGroot, Condor, 36, 1934, p. 8.

Mono Co. 8500 ft. Nest with eggs near Goshawk nest, June. J. B. and R. E. Dixon, Condor, 40, 1938, p. 9.

Mono Co. 9000 ft., pine near Virginia Lakes; young ready to leave nest, July 6, 1927. J. S. Rawley, Condor, 41, 1939, p. 252.

Dillon Beach, Marin Co. 10 pairs—May 20 to June 27 (artificial habitat). F. A. Pitelka, Condor, 44, 1942, p. 173.

Mt. Waterman (7000-8500 ft.) July 14, 1897, brooding ♀ taken; brood following parents a few days later. J. Grinnell, Pasadena Acad. Sci. Publ. No. 2, 1898, p. 35.

Ft. Tejon. Eggs taken June 7 (year?) in U. S. Nat. Mus. Collection.

Faith Valley. Nest with young, Aug. 4, 1919. F. N. Bassett, MS.

COLORADO

Denver. Three nests in lilac bush; eggs May 17, 1898. F. M. Dille, Condor, 2, 1900, p. 73.

Denver. Starts nesting about middle of March; eggs sometimes by April 7. W. H. Bergtold, Wilson Bull., 24, 1917, p. 124.

Denver. Nesting dates range from April 21 to May 28. R. J. Niedrach, in letter.

Boulder, and breeding in adjoining mountain to timberline. J. Henderson, Univ. Colorado Studies, 6., 1909, p. 236.

Ivywild, El Paso Co., May 16, 1913, nest. C. E. H. Aiken and E. R. Warren, Colorado Coll. Pub., Gen. Ser. 75 and 76, p. 559. June-September, 1914.

IDAHO

Coeur d'Alene. Young siskins able to fly noted June 17. A. J. Rust, Condor, 17, 1915, p. 127.

IOWA

Sioux City, building nest, April 3, 1926; nest with eggs, May 20, 1928. M. Dales and W. W. Bennett, Wilson Bull., 36, 1929, p. 74.

Sioux City, April 13, 1914. 3 eggs. W. J. Hayward, Wilson Bull., 26, 1914, p. 140.

Sioux City, nesting May 8, 1930. Wm. Youngworth, Wilson Bull., 43, 1936, p. 310.

KANSAS

Wichita, nesting, April 15, 1915. M. H. Swenk, Wilson Bull., 44, 1937, p. 116.

MAINE

Cumberland Co., one nest taken (Mead); North Bridgton, nest April 24, 1878. O. W. Knight, Birds of Maine, 1908, p. 390.

MASSACHUSETTS

Cambridge, nest in May, 1859. J. A. Allen, Auk, 4, 1887, p. 286.

Newton, May 29, 1883, nest found by D. W. Park. W. Brewster, Birds of the Cambridge Region, 1906, p. 263.

MICHIGAN

Porcupine Mts., Ontonagon Co., July 15—August 14, 1904, birds in breeding condition carrying nesting material. W. B. Barrows, Michigan Bird Life, 1912, p. 479.

Sault Ste. Marie, 3 young just from nest, June 12, 1918. M. J. Magee, MS.

MINNESOTA

Eveleth, St. Louis Co., 1918 (O. B. Warren).

Pine County. Young birds, early July. (T. Surber). T. S. Roberts, Birds of Minnesota, 2, 1932, p. 365.

MONTANA

Bozeman. Nest in valley among cottonwoods. A. A. Saunders, Condor, 14, 1912, p. 216.

Bozeman. Four young left nest August 19, 1909.

Belton. Young on wing August 21, 1915.

Middle Creek, Gallatin Co., 4 eggs, June 26, 1909. A. A. Saunders, Pacific Coast Avifauna 14, 1920, p. 112.

Flathead National Forest. Nesting, June 20—July 20, 1916. J. L. Sloanaker, MS.

NEBRASKA

St. Edward, Boone Co. Building nest April 18, 1938. D. Anderson, Nebraska Bird Review, 6, 1938, p. 29.

Omaha. Nest April 23, 1933—Omaha Nature Study Club. Nebraska Bird Review, 5, 1937, pp. 70 and 79.

Red Cloud. Young just from nest being fed by parents, May 26 to June 5, 1938. G. W. Trine, Nebraska Bird Review, 6, 1938, p. 29.

- Hastings. Nest and eggs, May 4, 1938 (young left nest May 25). Nelle Rowe, *Nebraska Bird Review*, 6, 1938, p. 29.
- Red Cloud. Pair gathering nesting material, April 26, 1925. C. S. Ludlow, MS.
- Omaha. Nest May 7, 1904. (J. E. Wallace).
- Benson, May 13, 1928 (L. O. Horsky).
- Superior. Nests March, 1907; April, 1923 (H. C. Johnson); April 8, 1925, (Mrs. King).
- Lincoln. May 28, 1907, building (Prof. L. Bruner); May 6, 1911 (F. H. Shoemaker); May 16, 1915 (R. W. Dawson); March 15, 18, 31, April 18, 19, 22, 24, 1917, nests found by C. E. Mickel; late April and early May, 2 nests, 1923, (L. Worley); May 10, 1924, (Mrs. Hole).
- Wahoo, Saunders Co. Nest March 15, 1926 (March 31—3 eggs) (M. St. Martin).
- Fairbury. May 30 to June 2, 1928, young birds (H. F. Hole). M. H. Swenk, *Wilson Bull.*, 41, 1929, p. 77.

NEW HAMPSHIRE

- Hanover. Nests with eggs found in two years in April.
- Webster. Pair building late April, 1900. G. M. Allen, *Proc. Manchester Institute*, 4, 1903, p. 136.

NEW MEXICO

- Cloudcroft, Otero Co., 8600 ft. Young birds June 13, 1943. R. F. and F. O. Hedges, *Condor*, 45, 1943, p. 237.
- Santa Fe. Eggs May 25, 1925. J. K. Jensen. MS.
- Pecos Baldy, 10,400 ft. Young calling for food, Aug. 17, 1903. V. Bailey.
- Santa Clara Canyon, Jemez Mts. Aug. 22, 1906, adult feeding 2 young. V. Bailey. F. M. Bailey, *Birds of New Mexico*, 1928, p. 699.

NEW YORK

- Ithaca. Newly hatched young, April 28, 1925, also other nests. A. A. Allen, in letter.
- Sing Sing. Four nearly fresh eggs found on May 25, 1883. A. K. Fisher, *Bull. Nuttall Orn. Club*, 1883, pp. 180, 181.
- Locust Grove. Young in nest April 13, 1878.
- Big Otter Lake. Young April 16-18, 1878. Florence A. Merriam, MS.
- Cornwall-on-Hudson. May. J. A. Allen, *Auk*, 4, 1887, p. 284.
- Remsen, April 4-9, 1889, breeding. Ralph and Bagg, *Trans. Oneida Hist. Soc.*, 12, 1912, pp. 16-85.
- Lyon's Falls, Black River Valley. Two sets of eggs; March 18 and April 20. (A. J. Dayan). C. H. Merriam, *Forest and Stream*, 10, 1878, p. 463.

NORTH CAROLINA

- Black Mt., Buncombe Co. Nesting observed by Cairns. C. S. Pearson and H. H. Brimley, *N. C. Geol. and Econ. Survey*, Vol. 4, 1919, p. 231.

NORTH DAKOTA

- Bismarck. Nest April 10, 1925; five other nests found during April and May, 1925. R. Reid, *Wilson Bull.*, 36, 1929, pp. 72-74.

OKLAHOMA

Cimarron Co. Nest with 3 eggs in pinyon tree on Marselus Bros. ranch, June 5, 1911. R. C. Tate, Proc. Oklahoma Acad. Sci., 1923, p. 47.

OREGON

Salem. Three eggs May 7, 1889. Keller, Oölogist, 8, 1891, p. 31.

PENNSYLVANIA

Warren. Ten nests April 14—, 1912. R. B. Simpson, Oölogist, 29, 1912, p. 372.

Warren, 1925 (R. B. Simpson).

Hull, Potter Co., spring 1925 (G. M. Sutton).

Hartstown, February, 1925, collecting nesting material (G. M. Sutton).

W. E. C. Todd, Birds of Western Pennsylvania, 1940, p. 616.

SOUTH DAKOTA

Yankton, nesting April 12, 1936. Wm. Youngworth, Wilson Bull., 43, 1936, p. 310.

Yankton, nesting April 26, 1926, eggs found. M. H. Swenk, Wilson Bull., 44, 1937, p. 116.

TENNESSEE

Near Cosby, 2,700 ft. in Great Smoky Mts. Specimen, young ♀ barely grown, July 2, 1937. Wetmore, Proc. U. S. Nat. Mus., 86, 1939, p. 234.

UTAH

Green Lake. July 4, juvenile birds seen being fed.

Paradise Park. July 7-10, family groups.

Bald Mountain. July 16-20, family groups.

Parley's Park. June 23, 1869, set of eggs; Aug. 10, 1868, two juvenile birds (Ridgway). A. C. Twomey, Ann. Carnegie Mus., 28, 1942, p. 462.

VERMONT

Woodstock. Young ready to leave nest March 19, 1925 (R. M. Marble).

E. H. Forbush, Birds of Massachusetts Vol. 3, 1929, p. 30.

Taftsville. Last of March, 1878, nesting, (eggs) recorded as Lesser Redpoll.

C. O. Tracy, Auk, 2, 1885, p. 99 (*ex Orn. & Oölg.*, 8, p. 47).

Barre. Pair nested 1941. Mrs. H. A. Drew, MS.

Rutland. Nest with young several days old, April 25, 1915. G. L. Kirk, MS.

Wells River. Adult seen feeding young bird October 5, 1934. W. P. Smith, MS.

Brattleboro. Two just out of nest April 14, *fide* Mrs. W. C. Horton. F. Os-good, Auk, 17, 1900, p. 295.

WASHINGTON

Tacoma. May 16, just hatching; May 21, just hatched; May 22, 3 fresh eggs; Aug. 14, 3 fresh eggs; also at intervening dates. Sept. 2, breeding. C. W. Bowles, Condor, 5, 1903, p. 15 and p. 20.

Kirkland. May 12, 4 half-incubated eggs; May 14, 4 fresh eggs; May 17, 4 fresh eggs. T. D. Burleigh, Auk, 46, 1929, p. 518.

Tacoma. Nest, eggs and young. March 28, 1924. Bowles, Murrelet, V, 1924, p. 7.

Westport. Building, May 22, 1920. D. E. Brown, MS.

WYOMING

Breeds near Laramie. Otto McCreary. MS.

Yellowstone Park. Frequent breeder. E. Kemsies, *Wilson Bull.*, 37, 1930, p. 207.

ALASKA

Forrester Island. Pair seen copulating, July 30, 1914. G. Willett, MS.

Chitina Moraine, 25 mi. W. of Alaska-Yukon border, June 4, a ♀ collected with egg nearly ready to lay; June 25 to July 14, 3 juvenile birds. Liang and Taverner, *Bull. Nat. Mus. Canada*, No. 66, 1929, p. 87.

Homer. Sept. 8, 1901, Two in juvenal plumage. Macoun, *Catalogue of Canadian Birds*, part 3, 1904, p. 446.

CANADA

BRITISH COLUMBIA

Mt. between Skagit River and Chilliwack Lake to 5,000' alt., both young and old seen in July, 1905 (Spreadborough). Macoun, *Catalogue of Canadian Birds*, part 3, 1904, p. 446.

Near Hazelton. July 19, 1921, bird seen feeding fully-grown young. Swarth, *Univ. Calif. Publ. Zool.*, 24, 1924, p. 350.

Telegraph Creek. Seen carrying nesting material during the first week of June; set of 3 eggs on June 20. Swarth, *Univ. Calif. Publ. Zool.*, 24, 1922, p. 238.

Okanagan Landing. March 18, 1918, pair seen carrying nesting material. J. A. Munro, *Canadian Field-Nat.*, 37, 1923, p. 73.

Errington, Vancouver Island. May 25, 1910, 2 young not long from nest. Swarth, *Univ. Calif. Publ. Zool.*, 10, 1912, p. 55.

Fort St. James. Eggs June 22, 1889. MacFarlane, through the Mackenzie Basin, 1908, p. 402.

MACKENZIE DISTRICT

Great Slave Lake, nesting on Moose Island June 24, incubation advanced. R. M. Anderson, *Condor*, 10, 1908, p. 234.

LABRADOR

Hamilton Inlet. Several nests with sets of eggs collected summers of 1895-1898, (one June 17, 1898)-(W. Raine) Macoun, *Catalogue of Canadian Birds*, part 3, 1904, p. 447.

NEW BRUNSWICK

Bathurst, Gloucester Co. Two sets of eggs taken May 12 and June 25, 1919. O. A. Francis, in letter of November 26, 1919.

Milltown. Eggs, 1868. Boardman, *Am. Naturalist*, 3, 1869, p. 222.

Wolfville, Kings Co. Eggs collected June 4, 1894; Aug. 4, 1894 (H. Tufts). Macoun, *Catalogue of Canadian Birds*, part 3, 1904, p. 445.

NOVA SCOTIA

Christie's Camp, near Two Rivers, March 29, 4 eggs slightly incubated. C. H. Morrell, *Auk*, 16, 1899, p. 252.

ONTARIO

East Toronto, April 13, 1916, nest with 2 newly hatched young in cedar tree;
May 20, old siskin feeding a fully fledged young bird. H. Lloyd, Auk, 34,
1917, p. 455.

Guelph. Eggs, May 7, 1905, ten nests found in all. Klugh, Auk, 22, 1905, p.
415 and Ottawa Nat., 19, 1905, p. 87.

Ottawa (vicinity), seven nests taken by Mr. Garneau. A. B. Klugh, Auk,
22, 1905, p. 415.

Upper Michipicoten River, Dog Lake, young seen Aug. 27, 1928. Fargo and
Troutman, Canadian Field Nat., 44, 1930, p. 31.

Bachawana Bay, Algoma Dist. Young bird taken August 7, 1935 (C. H. D.
Clarke).

Billing's Bridge, Carleton Co. Set of 5 eggs July 22, 1914 (C. L. Patch).

Oakville, Halton Co. Nests and 2 sets of eggs found by J. P. Turner, *vide* J. H.
Samuel, 1899.

Parry Sound District, E. Dixon has a set of 4 eggs.

Woodville, Victoria Co. Nest with 4 newly-hatched young, April 18, 1927;
Young flying on May 28, 1933. (F. Starr)—second at Bobcaygeon.

Pottageville, York Co. Newly completed nest April 3, 1927.

East York township, York Co. Building nest May 1, 1929. (R. J. Rutter).

East York township, York Co. Nest with two eggs, March 1895 (S. Carrell).
Baillie and Harrington, Trans. Royal Canadian Inst., 11, 1937, p. 266.

QUEBEC

Hatley. May 12, 1913, adult bird feeding fully grown young; deserted nest
(April?). H. Mousley, Auk, 33, 1916, p. 170.

Gaspé Basin. Nest with eggs found by Taverner, July 21, 1914. J. B. Demille,
Auk, 43, 1926, p. 521.

Gaspé. July 14, apparently nesting in village street (*ex* Brewster), 1884. Ma-
coun, Catalogue of Canadian Birds, part 3, 1904, p. 445.

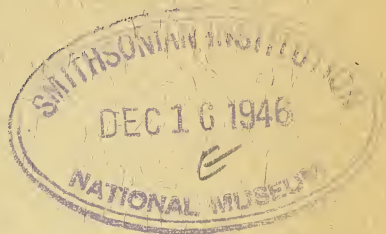
SASKATCHEWAN

Maple Creek. Young bird July 2. (L. B. Bishop).

Cypress Hills. Two young birds July 26 (L. B. Bishop). Bent, Auk, 25, 1908,
p. 30.

15
6842

ART. XVI. AN ANNOTATED LIST OF THE
BUTTERFLIES OF JAMAICA



BY A. AVINOFF AND N. SHOUMATOFF

Annals of the Carnegie Museum

Vol. XXX, p. 263-295

Issued December 13, 1946

Pittsburgh, Pa.



Outline-map of Jamaica to show the parishes in which collections were made.

ART. XVI. AN ANNOTATED LIST OF THE
BUTTERFLIES OF JAMAICA

BY A. AVINOFF AND N. SHOUMATOFF

(ONE PLATE)

The present list is an enumeration of all the Rhopalocera caught or observed by us on the island of Jamaica during our five visits between 1931 and 1940, and includes also other collections of Jamaican butterflies in the Carnegie Museum of earlier origin. In this list the localities are arranged by parishes in order to give a clearer idea of the distribution. The butterflies were taken by us in the summer months extending from June to mid-August, but exact calendar dates are not indicated in this catalogue. Records of the time of capture, likewise with only the month indicated, are included also in cases where forms were secured by other collectors in seasons when we were not present on the island, and, in some cases, of species not found by us. These have mostly been obtained by Miss Lilly Perkins, who has contributed so much to the knowledge of the Jamaican Lepidoptera, and also from Miss Evelyn S. Paine, Mr. T. Massey, and Mr. Chester Roys. Likewise we have included specimens collected in 1884 by Mr. Frederick W. Klages for Dr. W. J. Holland and now in the Holland Collection, and those collected by Mr. C. R. Baker in Jamaica about fifty years ago for the Carnegie Museum. All this additional material, together with our collection of Jamaican moths, has been incorporated in the collection which was assembled and presented by us to the Carnegie Museum, where, as a special regional unit, it is kept separate from the rest of the collection.

It may be mentioned that the collection of Jamaican Lepidoptera obtained by us in the course of our trips includes about 1,100 distinct forms, while the number of species of butterflies and moths, including Microlepidoptera, previously recorded from the island did not exceed 450. Obviously, the very large majority of these new records belong to the Heterocera since the butterflies have been far more thoroughly studied. Altogether, five new species and forms of butterflies required description, and four widely distributed butterflies, *Vanessa atalanta*, *Euptoieta claudia*, *Brephidium isophthalma*, and *Panoquina ocola*, we captured for the first time in Jamaica, thus correspondingly increasing the number of forms since the last check list of Jamaican Rhopalocera was issued by Kaye in 1928. Some of the forms, like *Danaïs cleophile*, recorded some fifty years ago by Godman and Salvin, and *Eunica monima*, had not been taken for a

10 16 145

number of years. *Chlosyne pantoni* is a markworthy instance of a rarity which had eluded our earlier and most intensive searches as was stated in our article (*Annals, Carnegie Museum*, vol. XXVIII, 1941, p. 311) describing the previously unknown female of this endemic and highly localized species. *Papilio marcellinus* proves to be a butterfly appearing periodically after long intervals of apparent absence. It has been observed again in the last two years after some twenty years had elapsed since its last recorded capture, which, in its own turn, occurred after a long period in which it had not been caught or seen anywhere. Incidentally, this phenomenon is duplicated in the instance of a spectacular endemic day-flying moth, *Urania sloanus*, which has not been seen on the island for well over fifty years, and indeed may have become completely extinct.

Three species of Rhopalocera, *Papilio marcellinus*, *Marpesia chiron*, and *Eunica tatilista*, represented in the Carnegie Museum in earlier collections, were not found in the course of our explorations, although they are included in this list. In order to bring this list up to date, two recent important finds, *Papilio andremon* and *Eurema gundlachia*, which have been recorded by Jamaican entomologists in the last two years, should be added. There are also several other butterflies which have been observed on the wing, either by us or by other entomologists, but have never been captured and the exact identity of such insects naturally remains uncertain or entirely conjectural. Thus, we have seen at Lowe River a small yellow and black-striped butterfly that could be either a Pierid or an Ithomid. Miss Perkins on several occasions has observed on the Rio Bueno a Pierid of an *Anthocharis* type, white with a bright orange tip on the front wings. Two collectors have reported strange and frankly doubtful observations of a large whitish Nymphalid near Montego Bay, and a black, red, and green *Papilio* (perhaps of the "*gundlachianus*" type) in the Blue Mountains. Furthermore, there are more or less doubtful references in literature, namely in the old work of Drury and in the article in the *Biologia Centrali-Americana* by Godman and Salvin. Three skippers which we have never seen on the island, *Panoquina panoquinoides*, *Astraptes cubana*, and *Astraptes chiriquensis*, have been listed in recent writings. Kaye ascribed to the fauna of the island a few doubtful and not authenticated skippers. The historical work on Jamaica by Sir Hans Sloane mentions the occurrence of some large Caligo-like butterflies with conspicuous ocelli on the under side of the wings. Whether all these scattered references will be ever verified and substantiated is a matter which may be settled only after further and more thorough explorations.

As far as the present state of our knowledge of the Jamaican *Rhopalocera* is concerned, this annotated list, with the above mentioned additions and reservations, constitutes a comprehensive summary. It includes the data recorded by us in our description of new forms in the *Annals of the Carnegie Museum*, and also those which have been mentioned in the recent writings of E. G. Huntington, and William Comstock, who have referred to some of our finds, especially in the *Lycaenids*.

The particular purpose of the present publication is to lay the foundation for the study of certain distributional problems. We have been impressed by the fact that there are many well-defined regions characterized by specific lepidopterological populations. It has been our especial purpose to investigate more closely the "classical" localities of the Blue Mountain region and also the "cockpit country" which heretofore has been imperfectly explored. These sections of the island have brought to light some interesting and novel distributional data. Certain similarities in the fauna of these two particular sections, which are affected least by cultivation and best preserve the primaeval character of the wilderness of this beautiful tropical island, have been clearly revealed. On the other hand, unique peculiarities have been demonstrated in the "cockpit" section, which is the unique abode of several endemic forms. Attention is drawn, for instance, to the distribution of *Papilio homerus* and *Chlosyne pantoni*, also to the peculiar western and eastern grouping of (a) *Phoebis hartonia* and *agarithe*, and *Eurema nicippe*, and (b) *Phoebis statira* and *comstocki* and *Eurema proterpia*. They seem to be two paralleling vicarious units in the two respective sections of the island. Another feature brought forth by the study of the present detailed list, is the somewhat isolated zoogeographical character of Bull Head Mountain, which we consider calls for further research.

Altogether, our explorations, as recorded in this list, indicate the need for a vast program of more intense ecological and distributional investigations by students of Jamaican entomology. In fact, the extent of the ecological differences shown at the various localities ranging from the luxuriant tropical vegetation of the Blue Mountain region and the dense forests of the "cockpit country" to the dry sections of the southern portion of the island, indicate the necessity of such intensive and careful comparative researches.

The nomenclature, especially the use of generic terms, is at present in a state of considerable flux. The current tendency to recognize obscure cases of priority, and the somewhat arbitrary fixation of genotypes has resulted

in a shift of generic names and in the loss of names which have been accepted in literature for a long period of time. We are inclined to adopt such alterations only with conservative reservations, especially in order not to confuse those students who do not have access to some of the out-of-the-way items of lepidopterological literature. No attempt has been made to evaluate the validity of arguments for or against the usage of certain generic and specific names which have been the object of diverse views in current writings. Our point of approach has been dictated by a policy of not dropping too hastily any term which has looked to us as a sufficiently justifiable instance of "nomina conservanda," like *Pieris* for example in preference to *Ascia*.

In conclusion, it may be said that this list, with its brief annotations, should be considered only as an offering of additional data and preliminary material, necessary for a revision of the *Rhopalocera* of Jamaica, and as a guide for collectors, and a help for future students of the fauna of the island.

LIST OF SPECIES

1. *Papilio homerus* Fabricius

Portland: Millbank (April, September, October), Fish Brook (August)

St. Thomas: Corn Puss Gap, Cuna Cuna Pass, John Crow Hill

Trelawney: Spring (Near Belmore Castle), Wilson's Run (Near Troy), Warsop, Accompong Town

St. Elizabeth: Paine (near Quickstep)

Formerly reported only from the Blue Mountain region. In the cockpit country it was encountered in ecological habitats similar to those in the vicinity of Bath. This butterfly is mostly observed near openings of tropical forests, flying along small mountain brooks. It is easy to catch. Individuals vary rather considerably in the degree of development of antemarginal markings on both wings. The females show occasionally a marked orange suffusion over the yellow discal bands of the hind wings. The cockpit specimens are particularly dark and brilliantly colored.

2. *Papilio pelaus* Fabricius

Portland: Fish Brook, Millbank (October), Haining

St. Thomas: John Crow Hill, Cuna Cuna Pass, Corn Puss Gap, Bath

St. Andrew: Hermitage

St. Ann: Highgate

Clarendon: Bull Head

Manchester: Christiana

Trelawney: Paine, Wilson's Run, Belmore Castle, Cotton Tree, Damascus, Warsop

Frequents shady paths, flies low and often settles on leaves of bushes. Not a swift flier.

3. *Papilio thersites* Fabricius

Portland: Fish Brook (August), Haining

St. Thomas: Morant Bay

St. Andrew: New Castle, Constant Spring

Trelawney: Belmore Castle, Baron Hill (April, May, July, October), Jackson Town (October), Pantrepant

Manchester: Coleyville

St. Elizabeth: Pedro Plain (March)

The males have a habit of circling steadily for a long time over open places surrounded by low trees on the tops of promontories. Never a common butterfly, it is quite local and the females are much more rarely seen than the males.

4. *Papilio thoas melonius* Rothschild and Jordan

Portland: Haining

St. Thomas: Hampton Court

St. Andrew: Constant Spring, Rae Town

Manchester: Christiana

Trelawney: Baron Hill, Belmore Castle

Hanover: Lucea

Westmoreland: Negril

St. James: Montego Bay

Has no specific haunts like the preceding species, is readily attracted by flowers. Rather rare and in some years not observed at all.

5. *Papilio polydamas jamaicensis* Rothschild and Jordan

Portland: Mill Bank, Haining

St. Thomas: Morant Bay, Hampton Court, Corn Puss Gap, Cuna Cuna Pass

St. Andrew: Constant Spring, Hope Gardens

Trelawney: Belmore Castle, Jackson Town (October)

Clarendon: Bull Head

Manchester: Christiana

The most frequent of all the Jamaican *Papilios*. Often seen in considerable numbers on blossoms in open places. Specimens often show the presence of bright red flower pollen on the reverse of the wings.

6. *Papilio marcellinus* Doubleday

"Jamaca" (June) Old specimen from Holland Collection

This species appears periodically at long intervals. It was observed recently, also about twenty years ago, and at a similarly long interval before that, with no recorded captures in between.

7. *Pieris monuste eubotea* Latreille

Portland: Ecclesdown, Hardwar Gap

St. Thomas: Hampton Court, Wheelers Field, Morant Bay, Bath, Corn Puss Gap, Albion

St. Andrew: Constant Spring, Hill Gardens, Hope Gardens, Hermitage, New Castle

St. Ann: Moneague, Lumsden

Clarendon: Alley, Milk River, Cumberland, Cave River

Manchester: Mandeville, Christiana

Trelawney: Warsop, Belmore Castle, Lowe River, Baron Hill

St. Elizabeth: Paine (near Quickstep), Black River

St. James: Queen of Spains Valley, Montego Bay

Hanover: Lucea

Common everywhere.

8. *Pieris amaryllis paramaryllis* Comstock

Portland: Buff Bay

St. Thomas: Morant Bay

St. Andrew: Newcastle

Clarendon: Portland Ridge, Cave River

Trelawney: Warsop, Burnt Hill, Damascus (observed flying but not captured), Pantrepant, Belmore Castle

A powerful flier with a very local distribution. Usually flies very high and alights briefly on tree blossoms away beyond the reach of a net.

9. *Appias drusilla jacksoni* Kaye

Portland: Buff Bay

St. Thomas: Hampton Court, Bath, Corn Puss Gap, Blue Mountain Peak

St. Andrew: Newcastle, Hermitage

St. Ann: Moneague, Mt. Diablo (or Diavolo), Lumsden (near Claremont)

Clarendon: Portland Ridge, Cave River, May Pen

Manchester: Mile Gully Hill, Christiana, Coleyville, Bethany

Trelawney: Wilson's Run, Baron Hill, Pantrepant, Warsop

St. Elizabeth: Malvern

St. James: Montego Bay

Hanover: Lucea

Widely distributed on the island and never rare. Flies very rapidly over open fields and slopes.

10. *Eurema proterpia* Fabricius

Portland: Balcarres, Spring Hill

Never before found on the island of Jamaica. It is restricted exclusively to a very small area of two to three miles of the road intersecting a slope which is probably the main habitat of this butterfly.

11. *Eurema nicippe* Cramer

St. Ann: Dry Harbor

Trelawney: Baron Hill, Duncans

St. James: Montego

This butterfly of the western part of the island is found rather sporadically in dry open places.

12. *Eurema adamsi* Lathy

St. Thomas: Blue Mountain Peak, Whitfield Hall

St. Andrew: Newcastle, Hermitage, Flamstead

St. Ann: Moneague, Mt. Diablo

Clarendon: Banana Ground (near Spalding)

Manchester: Mile Gully Hill, Coleyville

Trelawney: Baron Hill, Pantrepant, Belmore Castle

Usually found in the higher altitudes. A swift flier among dense bushes from which it rarely emerges. Because of its habits and its brisk irregular flight, this butterfly is very difficult to catch. The black band of the male varies in width, possibly depending on seasons and localities. The female was illustrated in a water-color drawing made by John Abbott in 1770. This illustration is included in a collection of one hundred plates by Abbott, formerly in the library of the senior author, which was presented by him to the Carnegie Museum.

13. *Eurema messalina* Linnaeus

Portland: Spring Hill, Haining, Buff Bay

St. Thomas: Bath, Hampton Court, Whitfield Hall

St. Andrew: Constant Spring, District of Port Royal, New Castle, Mavis Bank, Hermitage

St. Ann: Moneague, Dunn's River, Mount Diablo

Clarendon: Cave River

Manchester: Christiana, Coleyville

Trelawney: Baron Hill, Jackson Town, Cotton Tree, Damascus, Belmore Castle

St. Elizabeth: Malvern

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Negril

Flies very low and rather slowly among grass and small bushes.

14. *Eurema dina parvumbra* Kaye

Portland: Silver Hill Gap

St. Thomas: Hampton Court, Bath, Cuna Cuna, John Crow Hill, Corn Puss Gap, Whitfield Hall

St. Andrew: Constant Spring, Hermitage, Gordon Town, New Castle

St. Mary: High Gate

St. Catherine: Spanish Town

St. Ann: Lumsden, Moneague, Mt. Diablo

Clarendon: Cave River

Manchester: Christiana, Coleyville, Mile Gully, Victoria Town, Mandeville

Trelawney: Baron Hill, Burnt Hill, Paine, Wilson's Run, Lowe River

St. Elizabeth: Malvern

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Dolphin Head, Negril

Has habits similar to those of *E. adamsi* with which it is often seen in the same localities, although the habitat is more extended and it is not restricted to higher regions. The flight is rapid with sudden changes of direction.

15. *Eurema palmyra* Poey

Portland: Spring Hill

St. Thomas: Bath, Corn Puss Gap, Morant Bay

St. Andrew: Constant Spring, Hope Garden, Guava Ridge, Hermitage

St. Mary: Enfield

Clarendon: May Pen, Cave River, Milk River, Bull Head

Manchester: Christiana, Coleyville

St. Ann: Moneague

Trelawney: Baron Hill

St. Elizabeth: Black River

Westmoreland: Negril

The distribution is wide, and it is not restricted to any particular ecological habitat. A slow flier in open places with low flowering plants. It should be mentioned that *Eurema ebriole*, which is ascribed to the Jamaican fauna, is considered by most lepidopterists as the winter form of *palmyra*. *E. ebriole* was not taken by us in the course of our several summer seasons of collecting.

16. *Eurema elathea* Cramer

Portland: Buff Bay

St. Thomas: Morant Bay

St. Ann: Dry Harbor

St. Elizabeth: Black River

St. James: Montego Bay

Hanover: Lucea

A localized butterfly which appears in considerable numbers in its regular haunts, where *palmyra* occurs in marked minority. Flies near low bushes, more swiftly than *palmyra*.

17. *Eurema lisa euterpe* Ménètries

Portland: Spring Hill, Balcarres, Buff Bay, Hardwar Gap

St. Thomas: Hampton Court, Morant Bay, Bath, Corn Puss Gap

St. Andrew: Constant Spring, Hill Gardens, New Castle

St. Ann: Moneague

Clarendon: Bull Head

Manchester: Mile Gully Hill, Mandeville, Christiana

Trelawney: Allsides, Lowe River, Paine, Wilson's Run, Baron Hill

St. Elizabeth: Malvern

Everywhere common.

18. *Nathalis iole* Boisduval

Portland: Silver Hill Gap, Balcarres

St. Thomas: Whitfield Hall

St. Andrew: Newcastle, Guava Ridge, Yallahs River, Torre Garda

St. Mary: Enfield, Highgate

St. Ann: Moneague, Lumsden

Clarendon: Bull Head, Cave River, Cumberland

Manchester: Christiana, Coleyville

Trelawney: Warsop, Wilson's Run, Lowe River, Jacksontown

St. Elizabeth: Accompong

Flies very low over the ground on open paths and slopes. Often alights on the ground.

19. *Nathalis iole* ab. *albida* Avinoff and Shoumatoff

Trelawney: Lowe River

Found predominantly on the mountain top among regular yellow specimens. It was encountered in only one year and has not been found since at the same spot when it was visited later.

20, 21, 22. *Kricogonia terissa* Lucas

Portland: Balcarres

St. Thomas: Morant Bay, Bath, Corn Puss Gap

St. Andrew: Constant Spring, Hermitage

St. Ann: Moneague, Lumsden

Clarendon: Milk River

Trelawney: Jacksontown, Baron Hill

St. James: Montego Bay

Hanover: Lucea

***Kricogonia lyside* Latreille**

Portland: Haining

St. Thomas: Morant Bay, John Crow Hill, Corn Puss Gap

St. Andrew: Constant Spring, New Castle

St. Mary: Highgate

St. Ann: Moneague, Lumsden

Trelawney: Baron Hill

***Kricogonia lyside* ab. *unicolor* Godman and Salvin**

St. Thomas: Corn Puss Gap, Bath, Hampton Court

St. Andrew: New Castle, Constant Spring

St. Ann: Lumsden, Moneague

Trelawney: Baron Hill

Hanover: Lucea

These two species and the sulphur form of the female of the latter usually fly together. They cannot be distinguished on the wing. Their separation was not recognized readily by former entomologists. In fact, the typical series in the Paris Museum contains both species under the same name.

23. *Phoebis eubule sennae* Linnaeus

Portland: Balcarres, Fish Brook

St. Thomas: Morant Bay, Bath, Albion, Corn Puss Gap

St. Andrew: Constant Spring, Hermitage, New Castle

St. Catherine: Spanish Town

Clarendon: Alley, Banana Ground

St. Ann: Dunn's River, Moneague

Manchester: Christiana, Coleyville, Mile Gully

Trelawney: Belmore Castle, Pantrepant (observed on the wing, but not captured), Baron Hill

Hanover: Lucea

Westmoreland: Negril

Distinguished under this name from the continental form.

Common everywhere at all times.

24. *Phoebis rorata comstocki* Avinoff

Portland: Haining, Balcarres

St. Thomas: Bath, Hampton Court

This eastern species is quite localized, and is never found together with the next.

25. *Phoebis agarithe antillia* Brown

St. Andrew: Hill Gardens, Rae Town

St. Catherine: Spanish Town

St. Ann: Runaway Bay, Moneague, Dry Harbor

Found west of a dividing line of the island, forming a boundary with the habitat of the preceding species.

26. *Phoebis hartonia* Butler

Clarendon: Cave River

Trelawney: Baron Hill, Warsop, Wilson's Run, Spring, Pantrepant (At Wilson's Run, and Spring, specimens were observed on the wing, but not captured)

Restricted to the cockpit country. Exceptionally swift flier. Like *amaryllis*, alights usually on blossoms of high trees.

27. *Phoebis statira cubana* D'Almeida

Portland: Haining, Balcarres

St. Thomas: Bath

An eastern species coinciding in distribution with *P. rorata comstocki*.

28. *Anteos lacordairei* Boisduval

Portland: Balcarres

Only a single record of a male. Never before found on the island. In that place the regular Jamaican *maerula* was not observed.

29. *Anteos maerula* Fabricius

St. Thomas: Hampton Court, Morant Bay, John Crow Hill, Corn Puss Gap, Albion

St. Andrew: New Castle, Constant Spring

St. Ann: Moneague

Clarendon: Cumberland

Manchester: Christiana

Trelawney: Lowe River

In the places where it occurs this butterfly is not rare. Sometimes numerous specimens fly at close intervals over the same pass.

30. *Danais plexippus* Linnaeus

St. Thomas: Hampton Court, Wheelersfield

Clarendon: Milk River, Cumberland

Manchester: Coleyville

Trelawney: Lowe River

Quite localized and not common.

31. *Danais cleophile* Godart

St. Ann: Mt. Diablo

32. *Danais jamaicensis* Bates

Portland: Haining, Buff Bay

St. Thomas: Bath, Hampton Court, Wheelersfield, Morant Bay, Whitfield Hall

St. Catherine: Rio Cobre

Clarendon: Milk River

St. Mary: Highgate

St. Ann: Moneague

Manchester: Victoria Town, Christiana, Coleyville

Trelawney: Lowe River, Baron Hill, Belmore Castle

St. Elizabeth: Malvern, Accompong

Hanover: Lucea

Widely distributed and not rare. Has a rather slow flight and gregarious habits. Usually found in open places, on flowers.

33. *Danais eresimus* Cramer

St. Thomas: Hampton Court

Clarendon: Milk River

Trelawney: Duncans

Hanover: Lucea

Westmoreland: Savanna-la-Mar

A rare butterfly, found in a few places in company with the preceding.

34. *Hymenitis diaphanus* Drury

St. Thomas: Cuna Cuna, Corn Puss Gap, John Crow Hill, Blue Mountain Peak (observed on the wing but not captured)

Only rarely recorded. Extremely localized, restricted sometimes to a stretch of land a half-mile across. In such places it is very abundant. A half-dozen specimens may be netted with one stroke since it flies very slowly. It never emerges into the bright sunlight from its dense humid habitat.

35. *Heliconius charitonia simulator* Röber

Portland: Silver Hill Gap, Buff Bay, Mill Bank

St. Thomas: Morant, Bath, Corn Puss Gap, Hampton Court, Blue Mountain Peak

St. Andrew: Constant Spring, Guava Ridge, Newcastle

St. Mary: Annotto Bay

St. Ann: Mt. Diablo, Moneague

Clarendon: Cave River, Bull Head

Manchester: Coleyville, Christiana

Trelawney: Baron Hill, Wilson's Run, Warsop

St. Elizabeth: Accompong, Black River

Hanover: Lucea

Westmoreland: Negril

A common butterfly found nearly everywhere. Occasionally it shows a tendency to settle for the night in great numbers on the same bush, clustering whole twigs.

Reversing his former opinion, William Comstock considers at present that the Jamaican form is a valid race and deserves a subspecific designation.

36. *Dione vanillae insularis* Maynard

Portland: Mill Bank, Buff Bay, Hardwar Gap

St. Thomas: Hampton Court, Wheelersfield, Bath, Corn Puss Gap, Morant Bay

St. Andrew: Constant Spring, Newcastle, Hill Garden
Clarendon: Alley, Milk River
St. Ann: Moneague, Lumsden
Manchester: Christiana
Trelawney: Lowe River, Allsides, Wilson's Run, Baron Hill
St. James: Montego Bay
Hanover: Lucea

Common everywhere at all altitudes.

37. *Colaenis julia delila* Fabricius

Portland: Balcarres, Silver Hill Gap, Spring Hill
St. Thomas: Hampton Court, Morant Bay, Corn Puss Gap, Bath
St. Andrew: Constant Spring, Newcastle, Hermitage, Gordon Town
Clarendon: Milk River, Bull Head, Cave River
St. Ann: Moneague, Mt. Diablo
Manchester: Mandeville, Christiana, Coleyville
Trelawney: Baron Hill, Lowe River, Warsop, Wilson's Run
St. Elizabeth: Accompong
St. James: Montego Bay
Hanover: Lucea

Not very common, as a rule, and difficult to catch on account of its alertness and quick flight. Loves bright sunlight.

38. *Euptoieta hegesia* Cramer

Portland: Haining, Mill Bank
St. Thomas: Wheelersfield, Hampton Court, Morant Bay, Bath
St. Andrew: Newcastle
Clarendon: Cave River, Milk River
St. Ann: Moneague
Trelawney: Baron Hill, Wilson's Run
St. Elizabeth: Black River
St. James: Montego Bay
Hanover: Lucea
Westmoreland: Negril

Widely distributed and never rare.

39. *Euptoieta claudia* Cramer

Clarendon: Bull Head

The first authentic record for Jamaica since the original unconfirmed indication by Cramer. Rather common in its habitat.

40. *Phyciodes frisia* Poey

St. Thomas: Hampton Court, Bath, Yallahs River, Albion

St. Andrew: Hill Gardens, Constant Spring, New Castle

Clarendon: Alley, May Pen, Bucknors

St. James: Montego Bay

Common in open places.

41. *Phyciodes proclea* Doubleday and Hewitson

St. Thomas: Corn Puss Gap, Bath, Cuna Cuna, John Crow Hill, Blue Mountain Peak

Clarendon: Cave River

Trelawney: Baron Hill, Cotton Tree, Belmore Castle, Spring, Pantrepant, Wilson's Run

St. Elizabeth: Accompong, Paine

A mountain form, appearing in numbers in its habitats. Flies low along paths.

42. *Phyciodes pelops aegon* Fabricius

St. James: Montego Bay

Even at Montego Bay it is restricted to an amazingly small area of a few hundred feet, on an incline that was indicated to us by a former collector. There, this small butterfly was seen in a limited number flying a few inches above the barren ground, exposed to bright sunlight.

43. *Chlosyne pantoni* Kaye

Trelawney: Wilson's Run, Belmore Castle, Warsop, Spring, Cotton Tree, Damascus

Also one old specimen marked "Jamaica" from the Holland collection

Rediscovered by us after the original finding by Mr. Panton and the subsequent captures by Mr. Klages and Miss Fountaine. The males are far more frequently seen than the dimorphic females. This butterfly occurs in considerable numbers hovering over the foliage of "jainta" trees. Certain flowering trees seem to attract the females. The species is restricted to the cockpit country, remote from cultivation.

Comstock erroneously considers this butterfly conspecific with *perezi* Herrich-Schaeffer.

44. *Cystineura dorcas* Fabricius

Portland: Buff Bay

St. Thomas: Hampton Court, Pera, Morant Bay

St. Andrew: Constant Spring, Hill Gardens

St. Catherine: Ewarton

St. Ann: Moneague, Dunn's River

Clarendon: Milk River, May Pen

Manchester: Victoria Town

Trelawney: Baron Hill, Pantrepant

St. Elizabeth: Malvern, Magotty

St. James: Montego Bay

Hanover: Lucea

Abundant and a slow flier among low bushes. Rather local in distribution and found there in restricted areas.

45. *Vanessa virginiensis* Drury

Portland: Hardwar Gap

St. Thomas: Blue Mountain Peak

St. Andrew: Torre Garda

Clarendon: Bull Head

Trelawney: Lowe River

Nowhere abundant.

46. *Vanessa cardui* Linnaeus

Trelawney: Baron Hill (October)

Exceptionally rare.

47. *Vanessa atalanta* Linnaeus

St. Thomas: Blue Mountain Peak

The first record from the island, a single specimen.

48. *Hypanartia paullus* Fabricius

St. Thomas: Corn Puss Gap, Blue Mountain Peak

Trelawney: Baron Hill, Wilson's Run, Pantrepant

St. Elizabeth: Accompong (observed on the wing, but not captured)

A mountain butterfly, usually resting on branches of tall trees. Has somewhat the habits and ways of flying of the *Grapta* species.

49. *Junonia zonalis* Felder

Portland: Haining, Buff Bay

St. Thomas: Bath, Hampton Court, Pera, Corn Puss Gap

St. Andrew: Hill Gardens, Constant Spring, Halfway Tree, Newcastle, Hermitage

St. Ann: Moneague

Clarendon: Milk River, Bull Head, Four Paths

Manchester: Christiana

St. Elizabeth: Accompong

St. James: Montego Bay

Hanover: Lucea

They fly low and in quantities on open fields. The flight is rapid, like a Vanessa.

50. *Junonia zonalis* (Melanic ab.)

St. Ann: Mt. Diablo

This solitary aberration was captured at a place where other forms of *Junonia* were not found.

51. *Junonia genoveva* Cramer

St. Andrew: Rae Town (March)

Apparently a distinct species. Not encountered by us.

52. *Junonia genoveva* (Melanic ab.)

"Jamaica" specimen from the Holland collection.

53. *Anartia jatrophae jamaicensis* Moeschler

Portland: Mill Bank, Haining, Buff Bay, Hardwar Gap

St. Thomas: Wheelersfield, Morant Bay, Bath, Hampton Court

St. Andrew: Hill Gardens, Constant Spring

St. Mary: Annotto Bay

St. Ann: Lumsden, Mt. Diablo

Clarendon: Cave River

Manchester: Christiana, Victoria Town

Trelawney: Lowe River

Rather common in places where it occurs. Prefers open places, roads, fields, and clearings near woods.

54. *Metamorpha stelenes lavinia* Fabricius

Portland: Mill Bank, Haining, Buff Bay

St. Thomas: Hampton Court, Morant Bay, Bath, John Crow Hill, Corn Puss Gap

St. Andrew: Constant Spring

St. Mary: Annotto Bay, Enfield

Manchester: Christiana

Trelawney: Belmore Castle, Pantrepant

St. Elizabeth: Accompong

Westmoreland: Dolphin Head

Better known under the name of *Victorina steneles*.

Sometimes common; attracted by fallen mango fruits. The Jamaican form is the typical representative of this species.

55. *Marpesia eleuchea pellenis* Godart

St. Thomas: Albion

St. Andrew: Mt. Diablo (observed, not taken)

Clarendon: Milk River

Trelawney: Baron Hill, Belmore Castle, Spring

St. Elizabeth: Accompong

A rare butterfly everywhere.

56. *Marpesia chiron* Fabricius

"Jamaica," from the Holland collection. No recent records.

57. *Eunica monima* Cramer

St. Thomas: John Crow Hill (observed but not taken), Hampton Court

Captured only on one trip to the island, after a long interval had elapsed since the last record many years ago.

58. *Eunica tatila tatilista* Kaye

St. Andrew: Rae Town

Not recorded recently.

59. *Dynamine zetes* Ménètries

Portland: Haining

St. Thomas: Hampton Court, Morant Bay, Corn Puss Gap, Yallahs River

St. Andrew: Mavis Bank, Hill Garden

Clarendon: May Pen, Cave River

St. Ann: Dunn's River, Moneague

Manchester: Christiana, Coleyville

Trelawney: Warsop, Spring, Belmore Castle, Baron Hill, Pantrepant (at Warsop, Spring, and Pantrepant, specimens were observed but not taken)

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Dolphin Head, Negril

Found on bushes and trees. Sits usually on leaves. Flies only short stretches, and not rapidly.

60. *Lucinia cadma* Drury

St. Thomas: Whitfield Hall

St. Andrew: Torre Garda

Manchester: Christiana

Trelawney: Baron Hill, Burnt Hill, Warsop, Belmore Castle (observed but not taken)

Exclusively on leaves of bushes, and trees like the preceding. Rarely seen on the wing.

61. *Adelphia abyla* Hewitson

St. Thomas: Corn Puss Gap, John Crow Hill, Bath

St. Andrew: Hermitage

Clarendon: Cave River

Manchester: Christiana, Coleyville

Trelawney: Baron Hill, Spring, Pantrepant, Warsop

St. Elizabeth: Accompong

Flies rapidly near bushes, especially "jainta," usually rests on leaves. Nowhere abundant.

62. *Gynaecia dirce avinoffi* Comstock

Portland: Haining (observed, not taken)

St. Thomas: Corn Puss Gap, Bath (March, July, August), John Crow Hill

St. Andrew: Kingston

Manchester: Mandeville

Trelawney: Troy

St. Elizabeth: Accompong

Prefers to sit on trunks of trees, head down. Usually found in dark shady places. A lizard was observed to snatch the ocellated lower point of the hind wing which looks like a head with brilliant eyes. These parts of

the wings are often torn off on specimens, whose lives were saved by this resemblance. A similarly mutilated specimen is illustrated by Sir Hans Sloane in his work on Jamaica issued in 1723.

63. *Ageronia februa antillana* Hall

St. Thomas: Hampton Court (observed, not taken)

Very few records. We saw only one specimen.

64. *Hypolimnas misippus* Linnaeus

St. Mary: Highgate (observed, not taken)

Only once seen on the wing. No specimens obtained by us. One specimen is in the Kaye collection.

65. *Chlorippe laure fabricii* Hall

Trelawney: Spring, Wilson's Run (observed, not taken)

Extremely local, in the cockpit country. Flies very rapidly near low trees, settling rarely on the foliage. Has a much more swift flight than *Adelphia* which it somewhat resembles.

66. *Coea acheronta cadmus* Cramer

Portland: Fish Brook

St. Thomas: Corn Puss Gap

St. Ann: Lumsden, Mt. Diablo

Manchester: Coleyville (observed, not taken)

Trelawney: Damascus (observed at Warsop, Belmore Castle, and Spring)

St. Elizabeth: Paine

Favors the foliage of tall trees. Nowhere common.

67. *Historis odius* Fabricius

Portland: Silver Hill Gap

St. Thomas: Morant Bay, Bath

St. Andrew: Torre Garda

Clarendon: Bull Head

Manchester: Christiana

Trelawney: Lowe River

St. Elizabeth: Accompong, Lacovia

St. James: Montego Bay

Hanover: Lucea

The generic name of *Aganisthos* is in more general use.

A powerful flier. Found on trees or in open regions on mountain tops.

May be attracted by "baits," such as molasses and crushed sugar cane.

68. *Anaea troglodyta* Fabricius

St. Thomas: Morant Bay

St. Andrew: Constant Spring

Clarendon: Alley, Four Paths, Portland Ridge, Milk River

St. Ann: Claremont

St. Elizabeth: Malvern, Accompong

Hanover: Lucea

Found only on trees.

69. *Anaea johnsoni* Avinoff and Shoumatoff

Clarendon: Cave River

Manchester: Coleyville

Similar habits. Local and rare. The protective coloration of the underside makes it hardly noticeable when at rest.

70. *Calisto zangis* Fabricius

Portland: Ecclesdown, Buff Bay, Mill Bank, Fish Brook

St. Thomas: Corn Puss Gap, John Crow Hill, Cuna Cuna Pass, Bath

St. Andrew: New Castle

Clarendon: May Pen, Bull Head, Cave Ridge, Portland Ridge

St. Ann: Moneague, Dunn's River, Lumsden

Manchester: Christiana, Mandeville

Trelawney: Spring, Baron Hill, Lowe River, Pantrepant, Wilson's Run

St. Elizabeth: Accompong, Paine

St. James: Montego Bay

Hanover: Lucea

Flies slowly among bushes. Is quite abundant in places.

71. *Libythea terena* Latreille

Portland: Balcarres (not taken)

Only one observed on the wing, dashing from one bush to another.

72. *Thecla simaethis jago* Comstock and Huntington

Clarendon: Bull Head, (Paratype, female)

Manchester: Kendal (January 19)

Stays on leaves of bushes.

73. *Thecla telea* Hewitson

Portland: Haining (observed, not taken)

St. Thomas: Hampton Court (not taken)

Manchester: Mandeville

Hanover: Lucea

In open fields with low vegetation.

74. *Thecla crethona* Hewitson

St. Ann: Mt. Diablo

Clarendon: Bull Head, Cave River

Manchester: Christiana, Coleyville

Trelawney: Baron Hill, Belmore Castle

Alights exclusively on tree foliage where it is practically invisible because of the bright green underside.

75. *Thecla pan* Drury

Portland: Haining (observed, not taken)

St. Thomas: Corn Puss Gap, Hermitage, Hill Garden, Constant Spring

St. Ann: Moneague

Clarendon: Bull Head

Manchester: Coleyville

Trelawney: Belmore Castle, Spring, Baron Hill

On bushes, flutters around and is sometimes rather frequently seen.

76. *Thecla celida shoumatoffi* Comstock and Huntington

St. Thomas: Cuna Cuna

St. Ann: Moneague

Manchester: Christiana, Coleyville

Trelawney: Lowe River, Allsides, Spring

In higher regions, in more open places, on bushes and flowering plants. Apparently becoming rare and not seen at all in certain years.

77. *Thecla columella cybira* Hewitson

Portland: Balcarres, Silver Hill Gap

St. Thomas: Hampton Court, Bath, Morant Bay, Corn Puss Gap

St. Andrew: Constant Spring, Hill Gardens

St. Ann: Moneague

Clarendon: Bull Head, Cave River, May Pen, Milk River

Manchester: Mandeville, Lowe River, Baron Hill

St. Elizabeth: Accompong

St. James: Montego Bay

Hanover: Negril

The most common representative of the genus on the island, occurring in open places.

78. *Thecla angelia pantoni* Comstock and Huntington

St. Thomas: Hampton Court

Trelawney: Baron Hill

St. Elizabeth: Black River

Hanover: Lucea

Very rare.

79. *Thecla limenia* Hewitson

St. Thomas: Morant Bay

Caught only once, and never seen since.

80. *Thecla martialis* Herrich-Schaffer

Portland: Haining

St. Thomas: Hector's River, Hampton Court, Albion

St. Mary: Highgate

Trelawney: Baron Hill

Hanover: Lucea

Not frequent. On wood clearings and in open fields.

81. *Thecla bourkei* Kaye

Trelawney: Baron Hill

Hanover: Lucea (observed, not taken)

No recent records since several captures by Miss Lilly Perkins.

82. *Thecla acis gosseii* Comstock and Huntington

St. Thomas: Hector's River

St. Andrew: Hill Garden

Clarendon: Alley

St. Elizabeth: Malvern

Hanover: Lucea

Found not infrequently on low bushes and trees.

83. *Thecla bazochii* Godart

Portland: Haining

St. Thomas: Hampton Court, John Crow Hill, Corn Puss Gap, Bath

St. Andrew: Constant Spring, Torre Garda

Manchester: Coleyville

Trelawney: Lowe River, Baron Hill

St. Elizabeth: Accompong, Malvern

St. James: Montego Bay

Hanover: Lucea

Flies rapidly over very low bushes. Quite difficult to observe and capture.

84. *Leptotes cassius theonus* Lucas

Portland: Silver Hill Gap, Balcarres, Haining, Spring Hill

St. Thomas: Bath, Morant Bay, Pera, John Crow Hill, Corn Puss Gap, Hampton Court, Yallah's River

St. Andrew: Hermitage, Hill Garden, New Castle, Mavis Bank, Guava Ridge

St. Mary: Annotto Bay, Highgate

Clarendon: Alley, Milk River, Portland Ridge, May Pen, Cave River, Bull Head

St. Ann: Moneague, Mt. Diablo

Manchester: Coleyville

Trelawney: Warsop, Baron Hill, Spring, Belmore Castle

St. Elizabeth: Accompong, Malvern, Black River

Hanover: Lucea

Westmoreland: Negril

A very common butterfly found everywhere outside of dense woods, usually on bushes.

85. *Leptotes perkinsae* Kaye

Portland: Haining

St. Thomas: Bath, Corn Puss Gap, Blue Mountain Peak

St. Andrew: Hermitage

Clarendon: Bull Head, Cave River

Manchester: Christiana

Trelawney: Burnt Hill, Lowe River, Warsop, Belmore Castle, Baron Hill

St. Elizabeth: Malvern

Hanover: Lucea

Rather rare; sits on foliage of trees.

86. *Hemiargus dominica* Möschler

Clarendon: Bull Head

Manchester: Cross Keys

Trelawney: Baron Hill, Burnt Hill, Belmore Castle, Spring

Hanover: Lucea

Quite rare; flutters around trees.

87. *Hemiargus hanno ceraunus* Fabricius

Portland: Balcarres, Buff Bay, Mill Bank, Home Bay (March)

St. Thomas: Bath, Morant Bay, Whitfield Hall, Hampton Court

St. Andrew: Constant Spring, Guava Ridge, Hill Garden

St. Catherine: Ewarton, Bog Walk

St. Mary: Highgate

St. Ann: Lumsden

Clarendon: Portland Ridge, Cave River, Milk River, Cumberland

Manchester: Coleyville, Christiana

Trelawney: Allsides, Lowe River, Baron Hill, Belmore Castle, Warsop

St. Elizabeth: Malvern

Everywhere on the island. Flies low on open places.

88. *Brephidium isophthalma* Herrich-Schaeffer

Clarendon: Milk River

First record for Jamaica. Found in abundance on an isolated field, scarcely a few hundred feet across, covered with succulent low vegetation.

89. *Urbanus proteus* Linnaeus

Portland: Spring Hill, Fish Brook, Haining

St. Thomas: Corn Puss Gap, Bath, Morant Bay, Albion, Hampton Court, Pera

St. Andrew: Constant Spring, Hill Gardens, Mavis Bank

St. Catherine: Bog Walk

St. Mary: Highgate

St. Ann: Moneague, Dunn's River

Clarendon: May Pen, Bull Head
Manchester: Christiana, Mile Gully Hill, Coleyville
Trelawney: Lowe River, Baron Hill
St. Elizabeth: Accompong, Malvern
St. James: Montego Bay
Hanover: Lucea
Westmoreland: Savanna-la-Mar, Negril

Of rather frequent occurrence, flies rapidly among bushes and flowering plants.

90. **Urbanus catillus** Cramer

Portland: Haining
St. Thomas: Albion, Vallahs River
Clarendon: Cave River
Trelawney: Baron Hill, Warsop, Belmore Castle, Stonehenge
St. James: Montego Bay
Westmoreland: Negril

A much rarer and more localized species. Usually seen on bushes.

91. **Proteides idas** Cramer

St. Thomas: Hampton Court, Bath
St. Andrew: Torre Garda
St. Mary: Highgate
Trelawney: Baron Hill, Belmore Castle
Hanover: Lucea, Savanna-la-Mar

Rare, found on bushes. Walcott designates this insular form under the name of *P. jamaicensis*.

92. **Proteides antaeus** Hewitson

St. Thomas: Bath
Clarendon: Cave River
Manchester: Mill Gully Hill
Trelawney: Baron Hill, Pantrepant
St. Elizabeth: Paine

Not frequent, found on bushes.

93. **Proteides asander** Hewitson

Portland: Haining
St. Andrew: Hermitage

St. Ann: Mt. Diablo, Claremont, Moneague

Manchester: Coleyville

Trelawney: Baron Hill, Warsop, Pantrepant

St. Elizabeth: Paine, Accompong

St. James: Montego Bay

Has the custom of sitting on the under side of leaves of bushes along paths.

94. *Proteides asander panthius* Herrich-Schaeffer

St. Ann: Claremont

St. Elizabeth: Paine

95. *Proteides perkinsi* Kaye

Trelawney: Warsop

Only one record, found on flowering bush (cheese wood).

96. *Polygonus amyntas* Fabricius

Portland: Fish Brook

St. Thomas: Bath, Corn Puss Gap, Hampton Court, Morant Bay

St. Andrew: Hermitage

St. Mary: Highgate

Clarendon: May Pen, Milk River, Bull Head

St. Ann: Moneague

Manchester: Mile Gully Hill, Mandeville, Christiana

Trelawney: Baron Hill, Warsop, Damascus, Cotton Tree, Pantrepant

St. James: Montego Bay

Hanover: Lucea

On leaves of bushes, rather frequently found.

97. *Astraptes jaira* Butler

Portland: Hope Bay (March)

St. Thomas: John Crow Hill, Corn Puss Gap, Bath

St. Catherine: Ewarton

St. Ann: Moneague, Mt. Diablo

Manchester: Mile Gully Hill

Trelawney: Baron Hill, Belmore Castle, Cotton Tree, Pantrepant, Wilson's Run

St. Elizabeth: Accompong, Paine

St. James: Montego Bay

In dark moist places, rather frequently seen.

98. **Astraptēs roysi** Avinoff and Shoumatoff

St. Thomas: Bath (March)

Only one record.

99. **Ephyriades arcas jamaicensis** Moeschler

Portland: Mill Bank

St. Thomas: Morant Bay, Hampton Court, Bath, Corn Puss Gap

Clarendon: May Pen, Bull Head, Portland Ridge

Manchester: Coleyville

Trelawney: Baron Hill, Belmore Castle, Spring, Pantrepant

St. Elizabeth: Accompong, Malvern

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Dolphin Head

On bushes in sunny places. Rather rare.

100. **Echelatus simplicior** Plötz

St. Thomas: Hampton Court, Corn Puss Gap, Bath

St. Mary: Highgate

St. Ann: Moneague, Lumsden

Manchester: Mandeville, Coleyville

Trelawney: Baron Hill, Lowe River, Belmore Castle, Spring

St. Elizabeth: Accompong, Paine

Westmoreland: Dolphin Head

On bushes.

101. **Timochares ruptifasciata** Plötz

St. Thomas: Morant Bay, Hampton Court

Clarendon: Alley

Trelawney: Baron Hill

St. James: Montego Bay

Hanover: Lucea

Rare. Affects exclusively thorny, dense bushes, rarely emerging into the open. Only occurs in arid regions.

102. **Grais stigmaticus** Mabilie

Trelawney: Paine, Belmore Castle

On bushes, along paths. Very rare.

103. *Achlyodes thraso* Hubner

St. Thomas: Bath, Hampton Court, Springfield

Clarendon: Bull Head

Manchester: Christiana, Coleyville

Trelawney: Baron Hill, Jackson Town

Hanover: Lucea

Hovers and darts over bushes, settling on leaves as a rule.

104. *Cabares potrillo* Lucas

Clarendon: May Pen, Bucknors

St. Ann: Dunn's River

Very local. Flies in abundance, low in the underbrush, under palm trees. It is a slow flier.

105. *Chiomara gesta* Herrich-Schaeffer

Portland: Silver Hill Gap, Spring Hill, Balcarres, Buff Bay

St. Thomas: Morant Bay, Hampton Court, Albion

St. Andrew: Mavis Bank, Constant Spring

Trelawney: Stewart Town, Baron Hill

St. Elizabeth: Malvern

St. James: Montego Bay

Flies low on open places, usually settles on the ground.

106. *Pyrgus syrichtus* Fabricius

Portland: Buff Bay (March), Millbank, Greenhills

St. Thomas: Bath (March, July, August), Corn Puss Gap, Hampton Court,
John Crow Hill, Whitfield Hall

St. Mary: Highgate

St. Ann: Moneague, Dunn's River, Lumsden

Clarendon: Alley, Milk River, Portland Ridge, Cave River

Manchester: Victoria Town, Mandeville, Christiana

Trelawney: Baron Hill, Wilson's Run

St. James: Montego Bay

Hanover: Lucea

On open fields; quite common everywhere.

107. *Catia vesuria* Plötz

Portland: Haining, Hope Bay

St. Thomas: Bath, Corn Puss Gap, Hampton Court

St. Andrew: Constant Spring

St. Mary: Highgate

St. Ann: Moneague, Mt. Diablo, Dunn's River

Clarendon: Portland Ridge, Bull Head, Banana Ground, Cave River

Manchester: Mandeville, Christiana, Coleyville, Mile Gully Hill

Trelawney: Lowe River, Belmore Castle, Wilson's Run (not taken), Spring, Baron Hill

St. Elizabeth: Accompong, Black River

St. James: Montego Bay

Frequently seen, everywhere, on open grounds.

108. *Hylephila phyleus* Drury

Portland: Mill Bank, Hardwar Gap, Buff Bay

St. Thomas: Bath, Pera, Morant Bay, Hampton Court

St. Andrew: Constant Spring, Hill Gardens

St. Mary: Highgate

St. Ann: Moneague

Clarendon: Milk River

Trelawney: Baron Hill

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Negril

Common in most places.

109. *Choranthus lilliae* Bell

St. Thomas: Corn Puss Gap, Hampton Court (observed, not taken)

Trelawney: Warsop, Spring

Local and very rare. Extremely difficult to catch. Usually sits on some leaf of a bush in a clearing, and flies up into the foliage of trees when disturbed. Its vision is apparently unusually acute. The female was discovered for the first time.

110. *Pyrrhocalles antiqua jamaicensis* Schaus

Portland: Haining

St. Thomas: Corn Puss Gap, Hampton Court, Bath, John Crow Hill

St. Mary: Port Maria, Highgate

St. Ann: Dunn's River, Moneague, Claremont

Clarendon: Cave River

Manchester: Christiana

Trelawney: Baron Hill, Burnt Hill, Warsop, Belmore Castle

Hanover: Lucea

Not common. Is usually attracted by flowering bushes, although also found occasionally sitting on leaves of bushes.

111. *Limochores insolita* Butler

Portland: Buff Bay

St. Thomas: Albion

Clarendon: Banana Ground, Bull Head

Manchester: Coleyville

Trelawney: Lowe River

Westmoreland: Negril

Found on open ground in arid places. Rare in the places of its occurrence, particularly the female which was not known previously. The spots on the wings of the female are rather variable.

112. *Lerodea tripuncta jamaca* Schaus

Portland: Mill Bank, Balcarres, Haining, Buff Bay (March)

St. Thomas: Bath, Corn Puss Gap, Morant Bay, Albion, John Crow Hill

St. Andrew: Newcastle, Constant Spring, Mavis Bank, Hope Gardens

St. Mary: Highgate

St. Ann: Moneague, Lumsden, Dunn's River

Clarendon: May Pen, Bull Head, Cave River, Alley, Milk River

Manchester: Christiana, Mandeville, Mile Gully Hill

Trelawney: Lowe River, Allsides, Burnt Hill, Warsop, Wilson's Run

St. Elizabeth: Accompong, Black River

St. James: Montego Bay

Hanover: Lucea

Westmoreland: Negril

One of the most common Jamaican skippers. Flies low over the ground.

113. *Lerodea tripuncta sinepunctis* ab. nov.

Distinguished from the *jamaca* form of Schaus by the total absence of light spots in the males. Upper and lower wings uniformly dark. No other superficial differences from typical *tripuncta*. Taxonomic status may be clarified by further investigation.

Portland: Buff Bay, Balcarres

St. Andrew: Constant Spring

St. Ann: Dunn's River, Cave River, Bull Head

Trelawney: Lowe River

St. Elizabeth: Black River

Hanover: Lucea

This form occurs among the normal *L. tripuncta jamaca*. Type in the Carnegie Museum from Cave River.

114. *Lerodea eufala* Edwards

Clarendon: Bull Head, Cumberland

Trelawney: Allsides, Lowe River

Quite rare, on open arid grounds, usually on the tops of mountains. Has a rapid flight.

115. *Cymaenes silius* Latreille

Portland: Buff Bay, Spring Hill

St. Ann: Dunn's River

Clarendon: Cave River

Hanover: Lucea

Restricted distribution. Among favorite localities is the ground under palm trees.

116. *Calpodes ethlius* Cramer

St. Ann: Claremont (October)

Only one record in this collection.

117. *Rhinthon thermae* Kaye

Portland: Haining

St. Thomas: Bath

St. Mary: Highgate

Clarendon: Cave River

Trelawney: Warsop

The typical specimens were obtained only in Bath. Apparently, this species has a rather wide distribution but is everywhere quite rare. The favorite resting places are leaves of low bushes. Usually it sits on the under-side of the leaves.

118. *Panoquina sylvicola woodruffi* Watson

Portland: Buff Bay

St. Thomas: Bath, Hampton Court, Corn Puss Gap

St. Andrew: Constant Spring, Mavis Bank

St. Mary: Highgate, Guy's Hill, Enfield

St. Ann: Dunn's River, Moneague, Lumsden

Clarendon: May Pen, Alley, Banana Ground, Cave River, Bull Head, Milk River

Manchester: Mandeville, Christiana, Mile Gully Hill, Coleyville
Trelawney: Lowe River, Baron Hill, Wilson's Run (observed, not taken)
St. Elizabeth: Accompong, Malvern
St. James: Montego Bay
Hanover: Lucea
Westmoreland: Negril

Our specimens seem to be closer allied to this race than to the typical form. A widely distributed skipper which scarcely justifies its specific name since it is more frequently found in open places than in the forests.

119. *Panoquina ocola* Edwards

Clarendon: Bull Head
St. Elizabeth: Black River

On dry, open places. Apparently very rare.

120. *Panoquina nyctelia* Latreille

Portland: Haining
St. Thomas: Mavis Bank, Hampton Court, Hector's River, Morant Bay, Bath,
Corn Puss
St. Andrew: Constant Spring, Mavis Bank
St. Mary: Guy's Hill
Clarendon: Bull Head, Alley
Trelawney: Jackson Town, Baron Hill, Lowe River
St. Elizabeth: Accompong
St. James: Montego Bay
Hanover: Lucea

Widely distributed but nowhere common.

121. *Perichares coridon* Fabricius

Portland: Mill Bank, Hardwar Gap
St. Thomas: Corn Puss Gap, Bath, Hampton Court
St. Andrew: Hope Garden, Constant Spring
Clarendon: May Pen, Milk River, Cave River, Bull Head
St. Ann: Moneague, Lumsden
Manchester: Mandeville, Christiana
Trelawney: Belmore Castle, Lowe River, Wilson's Run

In lists, usually misspelled "corydon." Found exclusively on the foliage of bushes. Sits head down on the underside of leaves where it can be easily captured. Forest paths are its most common places of occurrence.

507.13
24P6842

ART. XVII. CRITICAL NOTES ON THE WOODPECKERS

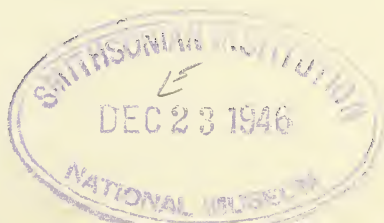
BY W. E. CLYDE TODD

INTRODUCTION

The Woodpeckers (Family Picidæ) have long been one of my favorite groups of birds. In several earlier papers I had occasion to discuss the systematics of certain species of this family, and to describe a number of new forms. With the recent completion of a study of all the woodpeckers in the collection of the Carnegie Museum, I find that we have no fewer than 3,939 specimens, representing 263 species and subspecies. Much of the critical comment developed in the course of this study must necessarily be reserved for future papers, but there are some cases which might well be given immediate publicity for the benefit of others. The present paper deals with such American forms represented in our collection as appear to be new, imperfectly understood, inadequately described, or presumably invalid. To the fourteen accepted forms of Woodpeckers the types of which are in the Museum collection, there are here added four more which are apparently new or unrecognized.

Acknowledgments are due to the authorities of the following institutions for the loan of specimens needed for comparison in making this study: the American Museum of Natural History; the Museum of Comparative Zoölogy; the University of Michigan Museum of Zoology; and the U. S. National Museum. I am also under obligations to Mr. N. B. Kinnear of the British Museum (Natural History) for making certain comparisons of material sent him for that purpose, and to Dr. Herbert Friedmann for a similar courtesy. Also, Dr. Friedmann and Mr. James Bond have supplied transcriptions of some original descriptions not available otherwise, and Mr. Samuel M. Klages has kindly made translations of some descriptions from the Portuguese. All measurements are in millimeters, and that for the bill is of the exposed culmen.

The number of genera to be recognized in this family is a debatable question, on which probably no two authors would agree. I do not hold with those who, like Ridgway, recognize an excessive number, nor yet with those who go to the other extreme and "lump" such apparently well-characterized groups as *Centurus*, *Tripsurus*, *Leuconerpes*, and *Chrysערpes* under *Melanerpes*. In my judgment more weight should be given to color pattern in discriminating the genera of Woodpeckers, aside from purely structural characters; it is often a good clue to their relationships.



***Centurus carolinus zebra* (Boddaert).**

Messrs. Burleigh and Lowery (Occ. Papers Mus. Zool. Louisiana State Univ., No. 17, 1944, 293-301) have lately worked out the races of this species. They left the northern range of the Mississippi Valley form indeterminate, as they had no specimens from east of Ohio. However, our specimens from Michigan, Ontario (Amherstburg), and western Pennsylvania clearly belong to this race, whose best character seems to be the distinct yellowish gray tone of the underparts—a feature which in southern specimens is mostly lacking. The relative amount of white on the upperparts, which these authors claim is another differentiating character, is not nearly so well marked, and it is moreover subject to variation from wear. In general, these northern birds have rather more white on the outer rectrices than southern examples have, but the difference is inconstant.

***Centurus aurifrons incanescens*, subsp. nov.**

Type, No. 113,850, Collection Carnegie Museum, adult male; 12 miles south of Marathon, Brewster County, Texas, May 5, 1933; George M. Sutton.

Subspecific characters.—Similar to *Centurus aurifrons aurifrons* (Wagler), as represented by fourteen specimens from Mexico (Coahuila and Nuevo Leon) and the lower Rio Grande region of Texas, but underparts paler gray (pale smoke gray of Ridgway); crown also paler gray (neutral gray to light neutral gray); forehead paler yellow; and nape orange rufous (in the brightest colored specimens) to aniline yellow (in the duldest colored—usually females); and yellow of the underparts paler.

Range.—"Big Bend" region of western Texas.

Remarks.—The *Picus aurifrons* of Wagler (Isis, 1829, 512) was described from "Mexico," and according to Salvin and Godman (Biol. Centr.-Am., Aves, 2, 1895, 418) the type came from the State of Hidalgo. I have seen no specimens from that state, but it is unlikely that those from Coahuila and Nuevo Leon would be different. As a series the latter are fairly uniform in the color of the underparts, which are between light grayish olive and smoke gray. The crown is wholly (female) or partially (male) neutral gray to deep neutral gray, with the frontal region decidedly yellow, and the nape ochraceous orange to Mars yellow. The western Texas birds (ten specimens examined) are so easily separable from the Mexican birds by the characters above listed that it is odd that Messrs. Sutton and Van

Tyne did not describe them together with the other new races from this region.

***Tripsurus pulcher* (Sclater).**

Three specimens: El Tambor, Santander, Colombia.

Chapman's collectors did not find this form in Colombia. It is allied to *T. chrysauchen*, and like this form, it has a white median dorsal stripe. But it is much smaller, and the red on the pileum is much more extensive, reaching as it does (in the male) to the nape, and leaving only a narrow band of yellow behind it. Females of the two forms are still more different from each other.

***Tripsurus cruentatus cruentatus* (Boddaert).**

A few years ago (Ann. Carnegie Mus., 25, 1937, 250) I commented on the strange relationship between this form and the *Tripsurus rubrifrons* of Spix and expressed the opinion that hybridism was the explanation. But now, after again reviewing the matter, I find myself favoring the alternative color-phase theory. Parallel cases are unusual but not unknown. The collector of these specimens (S. M. Klages) regarded them as belonging to one and the same species. The flaw in the hybridism theory, as I suggested at the time, is that we know of no region where "*rubrifrons*" occurs alone. Should such be found, it might put a different aspect on the case.

***Piculus xanthochlorus xanthochlorus* (Sclater and Salvin).**

Four male woodpeckers coming from the Santa Marta region of Colombia, and which I had identified as *Chloronerpes chrysochlorus aurosus* Nelson, were discussed in the paper in Ann. Carnegie Mus., 14, 1922, 237. The receipt of a pair of birds from the Maracaibo region of Venezuela has put the case in an entirely different light. The male of this pair (No. 88,771, Sabana de Mendoza) is closely matched by a Colombian male (44,616, Don Diego). The female (No. 90,769, Guachi), on the other hand, is strikingly different from the male. Its upperparts are much darker olive, with a decided grayish shade on the scapulars, inner secondaries, and tertiaries; moreover, the entire pileum and nape (with the crest) are not concolor with the back, as in the various races of *chrysochlorus*, but brownish yellow (raw sienna of Ridgway), in decided contrast; the throat is colored the same, but the maxillary stripe is paler, more buffy. Except

for the grayish tone on the inner remiges the bird fits the description and plate of *Chloronerpes xanthochlorus* Sclater and Salvin in Hargitt, Cat. Birds British Mus., 18, 1890, 73, pl. 1. This author remarks (p. 69, note) on the strange circumstance that both his supposed males had no red on the head and says that the female was unknown. Chapman (Bull. Am. Mus. Nat. Hist., 36, 1917, 347) records an undoubted female from Colombia, and he adds that it agrees with Hargitt's plate. It would appear, therefore, that up to this time all of the recorded specimens of *aurosus* happened to be males, while those of *xanthochlorus* were females. In other words, *aurosus* Nelson is based on the male, and *xanthochlorus* Sclater and Salvin on the female of one and the same species. It is fair to presume that both of Hargitt's specimens were wrongly sexed.

In reaching this independent conclusion I find I have been anticipated by Mr. W. H. Phelps, who has handled these very specimens and considerable additional material. He argues for the subspecific status of *xanthochlorus*, which he considers to be conspecific with *chrysochlorus*, and opines that it is a case of heterogynism, despite the discontinuous distribution thereby involved. On this point I do not agree with him at all. The characters shown by the female are to my mind more fundamental, and more significant, than the (perhaps fortuitous?) resemblance of the males of the two forms. But I agree with him as to the identity of Colombian with Venezuelan specimens, and I follow him in considering *aurosus* racially distinct, which on geographical grounds alone seems highly probable. See his discussion in Bol. Soc. Venezolana Cien. Nat., No. 56, 1943, 298-301.

***Piculus flavigula magnus* (Cherrie and Reichenberger).**

This form was described and named on the basis of its longer wing and heavier bill. The type came from Matto Grosso. Later (Bull. Am. Mus. Nat. Hist., 60, 1930, 177) Mrs. Naumburg, after examining the specimens in the Vienna Museum (including Natterer's material) stated that the "valley of the Amazon" is the dividing line between the two forms. From a study of our series (39 specimens) it appears, however, that the significant difference between *flavigula* and *magnus* is not so much in size as in coloration, particularly in the males. In *flavigula* the adult male has a conspicuous crimson malar stripe, which is wanting in *magnus*. In both sexes the yellow of the throat is obviously purer and more uniform in *magnus*. This form occupies *both* banks of the Amazon as far down as the

Rio Negro (at least). (Natterer's specimens from Manaus [Manáos] were both females, it will be noted.) It is a well-marked race, but its range is not at all as its describers supposed.

Messrs. Griscom and Greenway (Bull. Mus. Comp. Zoöl., 88, 1941, 200) call our birds a "puzzling series of intermediates." I have not seen topotypes of *magnus*, it is true, but I can discern no intermediate characters in our series.

***Piculus leucolaimus* (Malherbe).**

Twenty-three specimens: Buena Vista and Cerro Hosáne, Bolivia; Manacapurú (islands) and Rio Manacapurú, Brazil.

These are referred to by Mr. Carriker in the description of his supposed new race *australis* (Proc. Philadelphia Acad. Nat. Sci., 87, 1935, 318). He fails to list his material from Brazil with which he compared the Bolivian birds. Every character he gives for "*australis*" I find is a variable one within the series. For instance, in some examples the light markings on the underparts are rounded; in others they are linear. My suspicions are increased by Count Gyldenstolpe's remarks on Hellmayr's comparison of Rio Purús skins with Malherbe's types (K. Svenska Vet. Akad. Hand., 23, No. 1, 1945, 129). In my opinion it is quite unlikely that Matto Grosso specimens would be different from those coming from the eastern base of the Andes in Bolivia. Moreover, our Manacapurú specimens are absolutely indistinguishable from Bolivian skins. The record involves a considerable and unexpected extension of the heretofore known range.

***Chrysoptilus punctigula guttatus* (Spix).**

Sixteen specimens: Santarem, Brazil.

Several writers—Hellmayr, Cory, Chapman, Oliverio Pinto, Griscom and Greenway, and more recently Gyldenstolpe—have discussed the problem of geographical variation in this species, but not all has been said. Their material was mostly inadequate and unsatisfactory, and their conclusions are not in accord. Count Gyldenstolpe, who had more and better material than his predecessors, has discussed the matter at some length but has not reached definite conclusions, except as to the status of Griscom and Greenway's *pallidior*—a name which is based in part on our series above listed. After an independent study of these specimens I agree with him that *pallidior* is inseparable from *guttatus*, despite the fact that in the original description of the former the authors are careful to state that the "characters of this subspecies have nothing to do with [those of] *guttatus*

(Spix).” They compare their new form primarily with typical *punctigula* from French Guiana, from which it differs as they say.

Spix gave no locality for his *Picus guttatus* other than the “forests of the Amazon River.” His figure represents a somewhat dull-colored example of the race found at Santarem. Our No. 73,172 is a good counterpart of his figure. Hellmayr, who studied Spix’s type-specimen (Abhand. K. Bayerischen Akad. Wiss., II Kl., 22, 1906, 606), says that it compares favorably with two females from Manaus collected by Natterer. Manaus and Santarem are given as the only known localities of record. Count Gyldenstolpe (K. Svenska Vet. Hand., 22, No. 3, 1945, 118) accepts the former on Hellmayr’s authority as the restricted type-locality, but I cannot find that Hellmayr made any such definite restriction. Since we have no series of specimens from Manaus, and I do not know in fact which race of *punctigula* inhabits that region, I favor accepting Santarem instead as the type-locality. I am moved to do so on the ground of the series available from that place and because there is a specimen from Santarem agreeing in coloration and measurements with Spix’s type. It seems to me that this is the more reasonable procedure. If we take Manaus we cannot possibly be sure, as yet, of the application of Spix’s name: it might indeed refer to any one of three forms, as I shall show.

Hellmayr’s measurements of the type-specimen accord with those of the Santarem series. They are small birds as compared with those from the middle and upper Amazon, from which they are separable on this ground alone. As Count Gyldenstolpe remarks, there is great variation in color, ranging, as regards the upperparts, from orange citrine to buffy citrine. The barring of the upperparts, although variable, is on an average not so heavy as in middle and upper Amazon birds. The Santarem specimens differ from true *punctigula* of French Guiana much as indicated by Messrs. Griscom and Greenway in their description of “*pallidior*”—generally paler coloration, etc. Evidently these authors assumed that *guttatus* was the name applying to the population of the middle and upper Amazon, but in this I believe them to have been mistaken.

Two young in juvenal dress (March 25 and April 23) are duller and darker-colored; their throats are pure black. This is an interesting fact, indicating that the primitive form of this group was a black-throated bird. Hellmayr’s attempt (quoted by Count Gyldenstolpe) to distinguish the Brazilian bird from that of Guiana by a supposed difference in the character of the black markings on the throat fails entirely in the light of our series, although the two are distinguishable otherwise.

***Chrysoptilus punctigula rubidipectus*, subsp. nov.**

Fourteen specimens: Arucaú, Obidos, and islands near Obidos, Brazil.

Type, No. 84,484, Collection Carnegie Museum, adult male; Islands, Obidos, Brazil, April 30, 1921; Samuel M. Klages.

Subspecific characters.—Similar to *Chrysoptilus punctigula guttatus* (Spix) as represented by specimens from Santarem, but more brightly colored throughout, and the breast with a decided wash of crimson, which is usually confluent (in the adult male) with the red malar stripe.

Range.—Brazil, north of the Amazon, from the region of Obidos north-eastward to the French Guiana frontier, but the exact limits undetermined.

Remarks.—Malherbe's figure 5, plate 87, is a very good representation of this form and was probably made from a specimen of Brazilian origin. It resembles *guttatus* in its relatively small size (as compared with *speciosus*), but it differs in its brighter general coloration, with the crimson prominent. All of our specimens are richly colored, as it happens, but probably this race has a dull-colored phase, as do the other races. Since it stands out so well in series upon comparison with the other forms, I have no alternative but to describe it as new. The only uncertainty concerns the matter of assigning a definite range to *guttatus*. If, as I believe, this latter form actually came from the south bank of the Amazon, the way is open to describe and to name the north-bank bird. Quite possibly the range of the latter is limited on the west by the Rio Negro.

***Chrysoptilus punctigula speciosus* Malherbe.**

Twenty-seven specimens: Buena Vista, Bolivia; Hyutanahan, Nova Olinda, São Paulo de Olivença, Tonantins (opposite), Manacapurú, Caviana, and Rio Manacapurú, Brazil.

The amount and character of the variations this series shows parallel those in other races of this species. Notwithstanding, this form is readily separable from the Santarem bird by its larger size. One gets this impression as the two respective series lie side by side, and measurements confirm it. Moreover, the present race is duller and darker in general coloration than the other (when examples in the same phase of plumage are compared), and the barring on the upperparts is heavier. As in other races of this species, the intensity of the spotting on the underparts varies greatly. No. 98,960 is very heavily spotted below; 92,101, very lightly.

Hellmayr (quoted by Count Gyldenstolpe, K. Svenska Vet. Akad. Hand., 23, No. 1, 1945, 130) was uncertain what name upper Amazonian

birds of this species should bear. I accept for them Sclater's manuscript name *speciosus*, first published by Malherbe (Mon. Picidéés, 2, 1862, 181) and saved from being a *nomen nudum* only by the use of the name on his plate 87. Hargitt notes that the figure on this plate is mistakenly numbered 5 instead of 6, but Malherbe's intention is plain, as his text shows. Sclater's specimen came from the "Peruvian Amazon," and the figure correctly represents the present bird. The *Chrysoptilus guttifer* of Reichenbach, 1854, is racially unidentifiable, and the locality ascribed (Mexico) is an impossible one. So I pass over this name.

The present race inhabits the middle and upper Amazon Valley, west of the Rio Negro on the north bank. South of the Amazon it reaches the Rio Purús, and extends thence into Bolivia. Other records farther east I cannot place without actual examination of the specimens on which they were based.

Celeus innotatus innotatus Todd.

Description.—Male: upperparts in general, including pileum, sides of the head and neck, and wings externally, rich hazel, a little paler anteriorly, the upper back with a few (or no) small black spots, as likewise the wing-coverts; primaries broadly tipped and barred with dusky black, the barring becoming more or less obsolete on the outer webs of the feathers; tail like the back but rather paler (deep cinnamon), barred with black, and the middle rectrices tipped with black; chin, throat, and malar region Brazil red; rest of underparts deep cinnamon buff, with some scattered black spots, most numerous on the lower breast; "iris red to brown; feet dull plumbeous; bill dark horn, pale olive below" (Carriker). Wing (type), 121; tail, 66; bill, 23; tarsus, 18.

Female similar, but throat and malar region uniform with the rest of the underparts. Wing (No. 52,793), 119; tail, 64; bill, 21; tarsus, 19.

Range.—Lower Magdalena Valley and Rio Sinu region, but limits not known.

Remarks.—This species is apparently nearest to *C. loricator*, from which it differs in having the spotting of the upper- and underparts, wings, etc., very much reduced both in size and extent, leaving only a few small spots on the breast and upper back in adult males. The spotting above and below is a variable quantity.

Cory (Field Mus. Zool. Ser., 13, pt. 2, 1919, 453) has placed *innotatus* in the synonymy of *mentalis*, but in this he is entirely mistaken, although the admittedly inadequate description, quoted in the preceding paragraph

substantially as it appeared in Proc. Biol. Soc. Washington, 30, 1917, 5, may have seemed to justify this course. The present bird has nothing to do with *mentalis*, with which it has been directly compared. It is known from five specimens from Jaraquiel and one from Gamarra, Colombia. The discovery of a geographical variant of *innotatus* from farther up the Magdalena Valley makes the use of a trinomial necessary.

***Celeus innotatus degener* Todd.**

This is a smaller, paler race of *innotatus*, known only from three specimens from the type-locality; it is probably the form of the middle Magdalena Valley.

***Celeus lugubris* (Malherbe).**

Thanks to Dr. Herbert Friedmann, I have before me a transcript of Malherbe's original Latin diagnosis of this species (Bull. Soc. d'Hist. Nat. Dept. Moselle, Metz, 1851, p. 77); it is identical with that in the same author's "Monographie des Picidéés," 2, 1862, p. 19, except for the omission of one unessential phrase. The accompanying plate (54), purporting to represent the species, however, is composite. Figures 1, 3, and 4 agree more or less with Malherbe's diagnosis, while Figure 2, supposed to be the female, is really an unmistakable representation of the bird later described as *Celeus kerri* by Hargitt (Ibis, 1891, 605). We have a series of eleven specimens of a Woodpecker from Palmarito, Rio San Julian, Chiquitos, Bolivia, which fit the description and plate of *lugubris* as thus restricted, after allowance is made for the considerable individual variation in the barring of the upperparts. Although the light bars are wide in some examples and narrow in others, they are always buffy yellow in color, sometimes with a rusty tinge, but never rufous. The upper tail-coverts are usually yellow, like the rump.

Later authors have uniformly misapplied Malherbe's name *lugubris* to the form from Matto Grosso with rufous wing-bars and upper tail-coverts. Indeed, Mrs. Naumburg (Bull. Am. Mus. Nat. Hist., 60, 1930, 181) fixes Matto Grosso as the type-locality; but for this action there is no justification, since (so far as we know) the only form that occurs in Matto Grosso is the rufous-barred bird. In order to resolve the existing confusion, I propose (following Hargitt's lead) to restrict the application of Malherbe's name *lugubris* to Figure 1 of Plate 54 of his "Monographie," which figure would thus become the virtual type of his description. This shift leaves

the rufous-barred bird usually called *Celeus lugubris* without a name, unless we accept the *Celeus roosevelti* of Cherrie (Bull. Am. Mus. Nat. Hist., 35, 1916, 183) as its proper designation. Mrs. Naumburg thinks that *roosevelti* was based on an off-colored, immature individual of the species under discussion. If she is correct, we would have:

Celeus lugubris Malherbe, 1851. Bolivian Chaco. Eleven specimens examined.

Celeus kerri kerri Hargitt, 1891. Paraguay and northern Argentina. Six specimens examined.

Celeus kerri roosevelti Cherrie, 1916. Matto Grosso and Goyaz, Brazil, to eastern Bolivia. I have examined intergrades between this form and *kerri*. This is the *Celeus lugubris* of authors in general but not of Malherbe. Fifteen specimens examined, including six (Carnegie Museum) from Puerto Suarez, eastern Bolivia.

So long as there was a dearth of specimens fitting Malherbe's description of *lugubris* there was admittedly some excuse for the misapplication of this name, but now that these are available the situation clears up satisfactorily.

***Cerchneipicus tinnunculus occidentalis* Hargitt.**

Hellmayr (Nov. Zool., 17, 1910, 384) has discussed the variations shown by his series. From his remarks it appears that, while the Amazon population differs from that of eastern Brazil, the characters on which *angustus* Griscom and Greenway are based are not only unstable, but are by no means confined to birds from the region of the Rio Tapajóz; they occur in specimens from farther up the Amazon. I do not see how *angustus* can be maintained under these circumstances. We have thirteen specimens (including one from Buena Vista, Bolivia) which in my opinion are referable to *occidentalis*.

***Crocomorphus flavus flavus* (Müller).**

Thirty-two specimens of this form have been examined. French Guiana birds are topotypical of *flavus*; those from Brazil are mostly topotypes of *inornatus* Cherrie. A wide degree of variation is observable. In fresh plumage the general coloration is dull yellow, which fades to buff with wear. The wings externally are dusky in some individuals, auburn in others, with all degrees between. The light spotting or feather-tipping on the wing-coverts varies also in amount and character. *C. f. inornatus* was

based on a supposed difference in the color of the wings and their coverts—a difference which simply does not hold. Hellmayr (Nov. Zool., 17, 1910, 385) refers to similar variations in discussing specimens from the Rio Madeira. Consequently I cannot recognize *inornatus* on any grounds whatever.

Count Gyldenstolpe (K. Svenska Akad. Hand., 23, 1945, No. 1, 131, and 22, 1945, No. 3, 124) refers his specimens from the Rio Beni, the Rio Juruá, and the Rio Purús to *peruvianus* Cory, described from eastern Peru, on the ground of its deeper yellow coloration as compared with *inornatus*. At first glance our series from the upper Amazon, the Rio Purús, and Bolivia (one specimen from Buena Vista) appear more decidedly yellow than those from the lower Amazon, but on closer examination I find that this is simply because they are in fresher plumage than the majority of our lower Amazon birds. When specimens comparable for season and wear are compared the difference disappears. Of course, *peruvianus* may be a valid race, but I refer all our upper Amazon specimens to *flavus* proper. They vary quite as much as do the lower Amazon series.

Cniparchus hæmatogaster von Tschudi.

Some recent writers include this species in *Phlæocestes*, together with the other species formerly ranged with *Scapanus* (cf. Chapman, Bull. Am. Mus. Nat. Hist., 55, 1926, 367, note, 369). It differs from *Scapanus*, however, in its shorter, more rounded wing, and particularly in its crest, which is shorter, rounded and “bushy,” and composed of narrow, stiffened feathers. The banded inner webs of the remiges, to which Ridgway calls attention, are much like those found in *Phlæocestes robustus*, the type of the genus, and are therefore not distinctive, but the general color-pattern is another character which supports generic rank.

Megapicos pollens pollens (Bonaparte).

Ridgway (Bull. U. S. Nat. Mus., No. 50, pt. 6, 1914, 180) was not sure whether this species, the type of *Megapicos* Malherbe (1848-49) was really congeneric with “*Picus*” *hæmatogaster*, the type of *Cniparchus* Cabanis and Heine, 1863. It (*pollens*) differs in having the crest much longer and fuller, and composed of soft feathers; the nostrils are completely concealed by the antrorse prefrontal feathers; and the style of coloration is different. I therefore would follow Chapman (Bull. Am. Mus. Nat. Hist., 55, 1936, 368-9) in recognizing both *Cniparchus* and *Megapicos* as distinct from

Phlæoceastes. If these three groups are united, it would have to be under *Megapicos*, the oldest name.

Veniliornis fumigatus (D'Orbigny) and races.

Veniliornis fumigatus fumigatus, thirty-five specimens: La Cumbre de Valencia, Paramo de Rosas, Galipán, Silla de Caracas, Guamito, La Cuchilla, El Limon, Colonia Tovar, Pico Naiguata, and Santa Lucia, Venezuela; El Cauca, La Palmita, Ramirez, Cachiri, Bucaramanga, La Pica, Peña Blanca, Rio Negro, and La Cumbre, Colombia; Incachaca and Yungas de Cochabamba, Bolivia.

Veniliornis fumigatus exsul, four specimens: Sierra Nevada de Santa Marta (6000 ft.), Cerro de Caracas, and Paramo de Macotama, Colombia.

Veniliornis fumigatus tectricialis, one specimen: La Elvecia, Venezuela.

There was a time when I considered birds of this species from Venezuela to be recognizably distinct from those of Colombia. The latter I followed Chapman in calling *fumigatus*, although at that time I had not seen any specimens from the type-locality—Bolivia. The Venezuelan birds I accordingly described (Proc. Biol. Soc. Washington, 29, 1916, 97) as *exiguus*—a name long antedated by *reichenbachii* Cabanis and Heine. I was misled by Hargitt's treatment of this group in Volume 18 of the Catalogue of the Birds in the British Museum. A more recent and careful study of our series, which in the meantime has been considerably augmented, convinces me that there exist no sufficient grounds for separating birds from these respective countries under different names. Venezuelan birds average a little smaller than Colombian, and that is all. Variation in this series is excessive but appears uncorrelated with locality. There are apparently two phases, not according to sex nor season, but possibly due to age. One is golden brown; the other phase is much darker. At one time, after having examined the Colombian series in the American Museum, I thought I could make out Chapman's race *aureus* from western Colombia, but I now believe this was based on birds in the golden brown phase. We have specimens from Venezuela which compare favorably with others from the Western Andes. Chapman has since abandoned *aureus* (Am. Mus. Nov. No. 250, 1927, 1), while at the same time he described a supposed darker race from Peru (*obscuratus*), which latter Mr. Zimmer (Field Mus. Zool. Ser., 17, 1930, 210) finds also untenable; it was based on birds in the dark phase.

We have a pair of birds from Bolivia, the male of which is a close

counterpart of D'Orbigny's colored figure; the female is more golden brown in tone. These birds are fairly large, it is true, but some of the northern birds match them in this respect. I feel that no satisfactory distinction can be made between specimens from the northern and the southern extremities of the range. On the whole *Veniliornis fumigatus* appears to belong to the Subtropical Zone, but some of the specimens from Venezuela come from lower elevations.

My independent study of this species, I now find, agrees well enough with Zimmer's recent results (*cf.* Am. Mus. Nov. No. 1159, 1942, 5-9). However, Zimmer reinstates *obscuratus* from Peru, and by implication recognizes *reichenbachii* of the Caracas region of Venezuela—to which I do not agree. His most important finding is that the dark-colored birds are immature, as is shown by the different shape of the outer rectrices and remiges. I have verified this in our series. However, the dark-colored individuals are not all males, as he believes. We have one such specimen which is a female and which is losing the crimson feathers on the crown and is acquiring golden brown feathers on the breast. In some of these specimens the skulls are thin. Curiously enough, the wings and tail appear fresher, less worn, in these dark-colored birds than in the golden brown ones.

Mr. Zimmer very properly queries the validity of the Santa Marta *exsul*, which I described on the basis of four specimens (Proc. Biol. Soc. Washington, 33, 1920, 74). The chief character given was its generally darker coloration, which in view of the observable variation in this species is a character of questionable value. Now I find that this race is barely recognizable from *fumigatus* by its larger size (average), and particularly by its longer tail, which runs 60 mm., as against a maximum of 55 mm. in the nominate form. In color it is certainly close to Bolivian skins of *fumigatus*, both phases of which are represented, except that the posterior underparts are not paler colored, as in that form, but uniform with the rest. For the present the race may be allowed to stand.

***Veniliornis chocoensis* Todd.**

This form was based on two males, one each from Potodo and from Malagita, in western Colombia. A fuller description is in order:

Pileum dull brown, the feathers of the forehead tipped with dark buff, those of the crown with crimson, in gradually increasing amount towards the nape, which has an indication of a buffy yellow posterior margin; back

and wings externally (except outermost primary) rich golden brown; upper tail-coverts and tail irregularly barred with dusky and dull golden buff; inner webs of remiges with buffy white spots; sides of head dull brown; entire underparts heavily barred with buffy white and deep black, in fairly regular pattern, the breast strongly washed with ochraceous tawny; under wing-coverts buffy white, barred with black; "iris reddish brown; feet plumbeous olive; bill blackish horn-color, bluish flesh-color below" (Carriker). Wing (type), 94; tail (worn), 48; bill, 20; tarsus, 15.

This form apparently represents *Veniliornis cassini* in the Tropical Zone of western Colombia. It differs therefrom in having plain wing-coverts, and in being more heavily barred below, with the dark bars predominating. I think it will have to stand as a full species.

***Veniliornis passerinus* (Linnaeus) and races.**

Veniliornis passerinus tapajozensis Gyldenstolpe, represented by eight specimens from Santarem, Brazil, is an excellent race, the characters of which I had noted shortly after the receipt of our specimens some years ago. It is readily separable by its rich coloration, with yellow prevalent; this is especially obvious in females. *V. passerinus insignis* Zimmer is rather brighter than typical *passerinus*, but duller than *tapajozensis*; from both of these it differs in its light-colored bill. It ranges on the south bank of the Amazon from the mouth of the Rio Negro (Caviana) west at least to São Paulo de Olivença, and south along the Rio Madeira. On the upper Rio Purús, however, it is replaced by another race, *V. passerinus agilis* (Cabanis and Heine), described from the Rio Napo, eastern Ecuador. Specimens from this general region compare favorably with our single example from Hyutanahan.

***Veniliornis passerinus saturatus*, subsp. nov.**

Twelve specimens: Mana, French Guiana.

Type, No. 63,141, Collection Carnegie Museum, adult female; Mana, French Guiana, August 30, 1917; Samuel M. Klages.

Subspecific characters.—Similar and nearest to *Veniliornis passerinus passerinus* (Linnaeus) of Cayenne, but general coloration darker and richer, the upperparts usually more or less washed with Mars orange, and the dark barring of the underparts obviously blacker, with less olivaceous shading.

Range.—Extreme western French Guiana, and probably extending east-

ward into British Guiana. Chubb's description of his British Guiana specimens (Birds of British Guiana, 1, 1916, 488) would suggest such a reference.

Remarks.—One would certainly not expect to find two different races of this (or any) species in as slightly diversified a country as French Guiana, yet so there are. The majority of our specimens are apparently immature, but these show the characters of the race equally as well as the adults, when compared with examples of true *passerinus* of the same age and in the same stage of plumage. However, immature females, although they have the crown red, are likely to have the back dull green (dark citrine), as do also some specimens marked as males.

Compared with *V. passerinus modestus* Zimmer of the middle Orinoco, this form is much darker above and below, with more crimson wash; it appears entirely distinct. The discovery of a new race of this extremely plastic species so close to the type-locality of *passerinus* is certainly a surprise. Of the latter we have twenty-eight specimens from Cayenne for comparison.

Veniliornis passerinus modestus Zimmer.

Two specimens from Palmar, at the eastern base of the Eastern Andes, in the State of Boyaca, Colombia, would on geographical grounds be referred to *Veniliornis fidelis* (Hargitt). However, they agree closely with an example from Maripa, Rio Caura, Venezuela, and with five others (Collection American Museum), identified by Zimmer as *modestus*, from the middle Orinoco. In describing this new race he carefully discriminated it from *fidelis*, to which form, however, he referred a specimen from Ayacucho, Rio Orinoco. The Palmar record considerably extends the ascribed range of *modestus* and suggests that the respective ranges of *modestus* and *fidelis* may overlap.

Veniliornis kirkii ceciliae (Malherbe).

Mr. Griscom agrees with Chapman (Bull. Am. Mus. Nat. Hist., 55, 1926, 366) in declining to recognize Ridgway's *darienensis*, but I am not so sure. Our seven specimens from the Atrato and Chocó regions of Colombia are perceptibly darker-colored than those from the coast region and the Magdalena Valley. The barring on the underparts is heavier; the upperparts are more rufescent; and often in evidence are dull crimson tips on the wing-coverts. For the present, however, I do not insist on the separation.

Dryobates villosus hyloscopus Cabanis and Heine.

We have eight specimens from the San Pedro Martir Mountains, northern Lower California. These have been separated as a distinct race, *scrippsæ* Huey (Trans. San Diego Soc. Nat. Hist., 5, 1927, 9), solely on the basis of their "decidedly smaller" size. Our specimens are comparable for season, but the difference in size fails to materialize. Five males from California measure: wing, 121-124; tail, 74-77; bill, 30-35. Five males from San Pedro Martir: wing, 119-122; tail, 74-77; bill, 30-32. I cannot see that a good case has been made out for the recognition of *scrippsæ*.

Dryobates scalaris cactophilus Oberholser.

After a careful study of our series of 73 finely prepared specimens of Cactus Woodpecker from north of the border, supplemented by certain specimens from other sources (including the type-specimen of *D. scalaris symplectus* Oberholser), I must confess that I can find no significant differences between birds from eastern Texas, Oklahoma, and Colorado on the one hand and those from western Texas, New Mexico, and Arizona on the other hand. The former (*symplectus*) are said to differ from the latter (*cactophilus*) by having the white bars wider, the black bars narrower, and the sides of the breast spotted rather than streaked. Also, the male is smaller, and there is more white on the pileum (*fide* Oberholser). Ridgway, comparing the two supposed races, merely says that *cactophilus* is "slightly larger, and with black bars on back, etc., decidedly broader" (than in *symplectus*). But when specimens taken at the same season and in the same stage of plumage are used for comparison, these alleged differences fade away. We have a good series of breeding birds from both regions, also birds in fresh unworn plumage, shot in September; they are strictly comparable, and are indistinguishable so far as locality is concerned. I cannot help but feel that Dr. Oberholser was misled into considering them as referable to two forms by the inadequate material then available, but there is no further excuse for continuing this treatment.

The type-specimen of *symplectus* is an individual with an unusual amount of white on the upperparts. I can detect no constant difference in color between *symplectus* and *cactophilus*, but there is a slight average difference in size, evident in the length of the wing. This distinction amounts to only a few millimeters and is completely bridged over by individual variation. In my opinion the entire series should bear the name *cactophilus*, which has page priority over *symplectus*. Moreover, the A. O. U. Com-

mittee must have regarded the Mexican form once known as *bairdi* as the same as *symplectus*, since they say that the latter is the earliest name for the present bird—*cf.* Check-List N. Am. Birds, ed. 4, 1931, 289. But if, as I insist, *symplectus* and *cactophilus* are indistinguishable, there remains no good reason for retaining the former name, whether or not the Mexican bird once known as *bairdi* is separable.

Van Rossem (Condor, 44, 1942, 24) has described two new races of this Woodpecker from southern California. I cannot make out either of these with our material, and I agree with Grinnell and Miller (Pacific Coast Avifauna No. 27, 1944, 244, note) that their recognition might well be held in abeyance.

***Dryobates borealis* (Vieillot).**

Ridgway (Bull. U. S. Nat. Mus. No. 50, pt. 6, 1914, 270, note) comments on the "decidedly shorter" wings of (peninsular) Florida specimens, but he does not venture to separate them subspecifically. Dr. Alexander Wetmore (Proc. U. S. Nat. Mus., 90, 1941, 498), after examination of a considerable series, takes this step and calls the southern form *hylonomus*. I am not inclined to accept this separation any more than does Ridgway; I consider that the actual difference in size between the two groups—a difference which applies to the wing alone—is too small to justify such a distinction. On the average, it is 113.8 mm. as against 119.2. If there were color differences too the form would have much better standing, but none are apparent. We have one specimen from Hillsboro County, Florida, which has a wing 118 mm. long—a figure within the size limit of typical *borealis*.

***Dryobates albolarvatus* (Cassin).**

Even with the aid of borrowed specimens from the U. S. National Museum collection I can find no justification for the recognition of *gravirostris*.

***Sphyrapicus thyroideus nataliæ* (Malherbe).**

Undeniably, the bills of Rocky Mountain birds of this species average shorter than do those from the Pacific coast, just as Swarth claims (Condor, 19, 1917, 62-65), but is the difference worth recognizing by name? Ridgway evidently thought not, and I doubt it myself.

***Picumnus squamulatus squamulatus* Lafresnaye.**

In recording a specimen of this species from the Santa Marta region (Ann. Carnegie Mus., 14, 1922, 234), I hazarded the opinion that the name

obsoletus, applied by Allen to the bird from El Pilar, northeastern Venezuela, was almost certainly based on an individual variant. But now come Messrs. Zimmer and Phelps (Am. Mus. Nov. No. 1270, 1944, 6), who contend that *obsoletus* is a valid race with a very restricted range. It must be restricted indeed, since our three specimens from the Cumaná region of Venezuela fail to show any peculiarities. These authors discriminate the Venezuelan bird under the name *rohli*, to which they assign all specimens from that country except topotypes of *obsoletus*. With every disposition to follow their findings, I have again gone over our series of this species (68 skins) with considerable care, and I cannot verify any of the differences on which they rely to separate Venezuelan birds from Colombian. Indeed, some of the most heavily marked examples in the series come from the coast region of Venezuela. There is considerable variation in the intensity of the markings, it is true, but some of this is seasonal; in worn plumage the dark feather-edgings tend to wear down more or less.

***Picumnus macconnelli macconnelli* Chubb.**

This form was described from British Guiana—supposedly. Hellmayr (Nov. Zool., 13, 1906, 349) compared birds from Pará with the type-specimen and found them identical therewith. Meanwhile Miss Snethlage (Orn. Monatsber., 14, 1906, 60) had based the name *amazonicus* on birds from this very region. Chubb figured the species in Volume 1 of his Birds of British Guiana, 1916, pl. 10, fig. 1. No other specimens from British Guiana ever materialized, but no suspicions as to the authenticity of the type-specimen arose until 1927, when Mr. N. P. Kinnear discovered that two of the specimens which Chubb had labeled *macconnelli* really belonged to an obviously distinct form. He thereupon proceeded to christen it *Picumnus cirratus confusus*. The type-specimen of *macconnelli* was without original data, and its source was open to doubt (*cf.* Bull. British Orn. Club, 47, 1927, 112-113). Now, it so happens that we have a series of 33 specimens of a *Picumnus* fitting the description and figure of *macconnelli* (32 from Santarem and one from Obidos). Five of these, together with five of a lighter-colored form from Mana, French Guiana, were sent to Mr. Kinnear for comparison, and his report is as follows:

"I think there is little doubt that *Picumnus macconnelli* comes from Brazil, and your specimens from Santarem agree with the type.

"The skins from Mana agree with the type of *P. cirratus confusus* if one allows for a slight difference due to the bad makeup of the type skin from the Takutu River and the only other skin from the Takutu Mts."

Mr. Kinnear thinks that *confusus* is a race of *cirratus* but is doubtful about *macconnelli* being one also. I have compared both forms directly with *cirratus* of southern and southeastern Brazil; and I feel that, although obviously related, they are best considered specifically distinct, not only by reason of certain significant differences, but also because of their separated range. On the other hand, the relationship between *macconnelli* and *confusus* is so close that I believe they ought to stand as conspecies—*P. macconnelli macconnelli* and *P. m. confusus*. Of the latter we have a series of 27 specimens. They differ from *macconnelli* in being more lightly banded below, with more brownish wash on the sides and flanks. It is probably in order to formally propose substituting Pará, Brazil, as the revised type-locality for *macconnelli*.

***Picumnus varzeæ* Snethlage.**

This is a remarkably distinct, isolated species, which was so inadequately described at the time than when Hellmayr first looked at our series, he declared they could not be *varzeæ*; but later he revised his opinion. A fuller description is in order:

Male: general color deep olive brown, with faint darker centers to the feathers of the back; wings a little darker (clove brown), the secondaries with inconspicuous paler edgings; tail black, the middle rectrices with the white markings usual in this genus; pileum and nape deep black, the feathers of the forehead and fore crown broadly tipped with English red, the hind crown and nape with very small white spots or dots; sides of head, the throat, and the fore breast brownish black, passing into raw umber on the lower breast, with faint darker centers to the feathers, and often with small white spots, irregularly disposed. "Iris dark vinaceous red; feet slate-color; maxilla black, with patches of horn gray on either side of the basal portion; mandible pale bluish gray with dark apex" (Klages). Wing, 52-56; tail, 29-31; bill, 13-15, tarsus, 13-15.

Female similar, but usually duller, more brownish, with paler feather-edgings on the abdomen, producing a slightly squamate effect; pileum deep black, spotted with white.

We have 72 specimens of this Piculet; all are from the islands in the Amazon near Obidos.

***Picumnus pusillus* Oliverio Pinto.**

Eighteen specimens: Manacapurú and Rio Manacapurú, Brazil.

This species was described from Codajaz on the north bank of the Rio

Solimoës, not far above Manacapurú, where also it was later taken by the same collector (*cf.* Oliverio Pinto, *Rev. Mus. Paulista*, 20, 1936, 234; and 23, 1938, 563). The description calls for a bird that is uniformly gray above, with only a light wash of olive; whereas our birds are dull dark citrine above, with faint darker centers to the feathers; the underparts are pale cream color or buffy white, paler on the throat, and regularly barred with dusky black, but not nearly so heavily as in *P. exilis buffoni*. In spite of these divergencies from the description I have little doubt of the identity of these specimens, if for no other reason that this was the only species of Piculet found at Manacapurú.

***Picumnus aurifrons* (von Pelzeln) and races.**

The nominate race comes from Matto Grosso, Brazil (Engenho do Gama, *vide* Naumburg); it is characterized by the streaking of the underparts below the breast. *P. aurifrons flavifrons* was described by Hargitt from Sarayacu, eastern Peru, and for a long time was known from the type alone. We have a pair of birds from Nova Olinda, a locality on the west bank of the Rio Purús. They agree precisely with a specimen from Teffé (Rothschild Collection) which Hellmayr had compared with Hargitt's type (*cf.* *Nov. Zool.*, 14, 1907, 80). The range of this form may now be defined as the region south of the Amazon and west of the Rio Purús. In this race the barring and spotting of the underparts are decidedly heavier and more distinct than in *P. aurifrons wallacii*. The pileum, however, is brown, not black, as is said to be the case in the type-specimen of *flavifrons*.

On the right bank of the Rio Purús, however, lives a Piculet which resembles *flavifrons* but is easily separable therefrom. It is duller and paler below, with the cross-barring on the breast less distinct, as also is the spotting on the abdomen. There is considerable variation in the exact character of these markings, however, in our series of thirteen specimens, which come from Arimã on the Rio Purús and Caviana on the south bank of the Rio Solimoës. They agree precisely with the two specimens from Humaythá on the Rio Madeira (Rothschild Collection) which were discussed by Hellmayr (*Nov. Zool.*, 14, 1907, 398), and also with the colored figure of *Picumnus wallacii* in the Catalogue of the Birds in the British Museum, 18, 1890, pl. 14, fig. 3. It is odd that Hellmayr should have failed to notice this correspondence; he calls these specimens *aurifrons*. In an earlier paper (*ibid.*, p. 80) he comments on the status of *wallacii*, which he suspects may be the same as *aurifrons*. He says that the type of the former is a

young bird and thinks its peculiarities "*may be* merely signs of immaturity." I doubt this, if for no other reason that in juvenal plumage these Piculets would scarcely have the pileum spotted as the plate represents; in allied forms the pileum is plain at this stage. The type of *wallacii* was said to have come from the "upper Amazon"—an indefinite locality, not to be taken too literally. The range of *wallacii* can now be assigned to the region south of the Amazon and between the Rio Madeira and the Rio Purús.

On the upper Rio Purús, however, lives a fourth member of this group, an apparently unnamed race which I propose to call

***Picumnus aurifrons purusianus*, subsp. nov.**

Type, No. 86,833, Collection Carnegie Museum, adult male; Hyutanahan, Rio Purús, Brazil, December 29, 1921; Samuel M. Klages.

Subspecific characters.—Similar to *P. aurifrons aurifrons* von Pelzeln of Matto Grosso, Brazil, but upperparts darker, less olivaceous; pileum duller brown, less blackish; breast more heavily barred; and posterior underparts with the markings inclining to spots. Similar also to *P. aurifrons flavifrons*, but breast more heavily barred, and posterior underparts not so distinctly spotted.

Range.—Upper Rio Purús, Brazil, but exact limits unknown.

Remarks.—This is a perfectly distinct form, easily separable in series from both *aurifrons* and *flavifrons*, although in certain characters it is intermediate between them. It is heavily marked below—much more heavily than any other member of this group, in which respect it approaches *P. lafresnayi*. In *P. aurifrons aurifrons* the underparts below the breast are definitely streaked; in the new form there are streaks, spots, and bars in confused pattern. Of this new race we have four specimens, all from Hyutanahan.

***Picumnus transfasciatus* Hellmayr and Gyldenstolpe.**

Six specimens: Colonia do Mojuy, Miritituba, Aveiros, and Santarem, Brazil. *Picumnus transfasciatus* is a strongly marked form; it is so different on comparison with *P. aurifrons* and its several races that I have no hesitation in according it specific rank, the more so as the birds of the middle Amazon and the lower Rio Purús show no signs of intermediacy.

The sedentary habits of these little Piculets and their inability to cross even secondary river barriers would seem to make them peculiarly susceptible to racial variations arising from isolation.

7.73
P6842



ART. XVIII. THE CEPHALOPOD FAUNA OF THE CONEMAUGH
SERIES IN WESTERN PENNSYLVANIA: SUPPLEMENT

BY A. K. MILLER AND A. G. UNKLESBAY
THE STATE UNIVERSITY OF IOWA, AND COLGATE UNIVERSITY

(PLATES I, II)

Some five years ago we prepared a report on the cephalopods of the Conemaugh series in western Pennsylvania, and the Carnegie Museum honored us by publishing it. Since that time, Mr. L. R. Collins of Pittsburgh has loaned us a collection of cephalopods that he assembled from the same general horizon and locality, and Reverend G. H. Smith of New Knoxville, Ohio, has sent us a few Conemaugh cephalopods, along with a wealth of other material. These two collections contain three new species, and other specimens that add materially to the existing knowledge of several of the previously known forms; and they constitute the basis for the present supplement to our prior study.

The type and figured specimens from Mr. Collins' collection are to be deposited in the Carnegie Museum, whereas those secured by Reverend Smith have been donated to The State University of Iowa. The photographs which accompany this report were retouched by Mr. Howard Webster of Iowa City. Also, we wish to acknowledge our indebtedness to the Graduate College of The State University of Iowa for making the preparation of this report financially possible, and to the Carnegie Museum for publishing it.

SYSTEMATIC PALEONTOLOGY

Poterioceras curtum (Meek and Worthen)

The Collins collection contains two representatives of this species but unfortunately both of them are so incomplete that they do not merit illustration. However, their affinities are definite, for they retain the test and it shows the characteristic surface ornamentation. Although a study of these specimens has not added to our knowledge of the morphology of the conch, they are important for they come from localities at which the species was previously not known to occur.

Occurrence: Brush Creek limestone at (1) Witmer and (2) west end of Sewickley bridge, near Sewickley, Pennsylvania.

Repository: Carnegie Museum, 25,786 and 25,787.

Ehippioceras ferratum (Cox)

(Plate I, figures 7, 8)

The specimen represented by figures 7 and 8 on our Plate I is the best representative of this ubiquitous species that has so far been found in the Conemaugh of Pennsylvania. It has an overall length of about 42 mm., and near the junction of the phragmacone and the living chamber the conch is about 32 mm. wide and 18 mm. high. Along the venter on the internal mold there is a very distinct raised line. There are some twelve camerae in the outer volution of the phragmacone of this specimen. The adoral two of these camerae are somewhat shorter than the preceding one, which suggests that this specimen represents a fully mature individual. The sutures form the prominent narrowly rounded ventral saddle and broad shallow rounded lateral lobes that are so characteristic of this species.

Remarks: In addition to the individual described above, the Collins collection contains a poorly preserved specimen that we are referring to this species with question. It came from the same horizon and locality as the figured specimen and seems to have been of the same general size and shape. Inasmuch as we are unable to ascertain the nature of its sutures, we are very uncertain in regard to its affinities.

Occurrence: Brush Creek limestone in the McFetridge Brick Company quarry of Creighton, Pennsylvania.

Repository: Carnegie Museum, 25,788 (figured specimen) and 25,789 (specimen referred to this species with question).

Coelogasteroceras dubium, sp. nov.

(Plate I, figures 5, 6)

(?) 1942. *Iiroceras* sp. Miller and Unklesbay, Ann., Carnegie Mus., vol. 29, pp. 137-138, pl. 1, fig. 13.

The holotype of this species (Pl. I, figs. 5, 6) is a well preserved almost complete internal mold, to which portions of the test adhere. The conch is moderately small, is subglobular in shape, and is expanded orad rather rapidly—the maximum diameter of the holotype measures about 28 mm. The whorls are low and broad, and, except in the adoral part of the living chamber of fully mature specimens like the holotype, they are broadly rounded ventrally and laterally and impressed dorsally. At the junction of the phragmacone and the living chamber of the holotype, the conch is about 17 mm. wide and 10 mm. high.

The preserved part of the living chamber of the holotype is about two-fifths of a volution in length. In the adoral half of it there is gradually developed a low broad shallow ventral groove or sulcus. The test is a little less than half a millimeter thick. Growth-lines on its surface form a moderately broad deep rounded ventral sinus and broadly rounded lateral salients. Also, on the internal mold there is a raised line along the venter.

The umbilicus is moderately large, the umbilical shoulders are fairly abrupt and distinct, and the umbilical walls are steep. The diameter of the umbilicus is equal to about a third that of the conch, and the maximum diameter attained by the umbilicus of the holotype (internal mold) measures about 9 mm.

The camerae are moderate in length, but the adoral two of the holotype are excessively short, suggesting that it is a fully mature individual. The adoral sutures of this specimen are distinctly sinuous, whereas the others are essentially straight and directly transverse. The sinuosity of the adoral sutures results in their forming a broad shallow ventral lobe and on either side of it a similar ventrolateral saddle. No trace of the siphuncle is visible on the holotype.

Remarks: The above description is based entirely on the holotype, but in addition we have available for study a rather poorly preserved paratype. This latter specimen does not retain the sutures, but it shows the general size and shape of the conch, the adoral ventral groove or sulcus, and the growth-lines. Also, as indicated by the synonymy, in 1942 we illustrated another rather poorly preserved specimen that may be conspecific.

We are somewhat uncertain in regard to the generic affinities of this species. Superficially it resembles typical *Liroceras*, but the ventral sulcus that it develops at full maturity suggests a relationship to *Coelogasteroceras*, of which the genotype is *Nautilus canaliculatus* Cox of the Lower Pennsylvanian of Kentucky. It seems to us that our species is more or less intermediate between these two genera, but, all in all, we believe that it is closer to *C. canaliculatum* than to any other genotype. Because of its uniqueness, little would be gained by detailed comparisons of *C. dubium* with other species.

Occurrence: Brush Creek limestone in (1) the Harvey Brick Company quarry near Glassmere (holotype and specimen referred with question to this species), and (2) an outcrop along the side of the highway west of the Sewickley bridge near Sewickley (paratype), Pennsylvania.

Types: Carnegie Museum, 25,790 (holotype) and 25,791 (paratype).

Metacoceras cornutum Girty

(Plate I, figures 9, 10)

It should perhaps be mentioned that the collections we are studying contain seven representatives of this species, which is exceedingly abundant in the Conemaugh. None of these is particularly well preserved, but that represented by figures 9 and 10 on our Plate I is the first to be recorded from the Ames limestone of southeastern Ohio.

Occurrence: Mr. Collins secured four specimens from the Brush Creek limestone near Creighton, Pennsylvania, and two from the Pine Creek limestone near Undercliff, Pennsylvania. Reverend Smith found the one illustrated in the Ames limestone near Trimble, Athens County, Ohio, in direct association with the smaller of the syntypes of *Stenopoceras smithi*, sp. nov.

Repositories: Carnegie Museum, 25,792-25,795 (Brush Creek specimens) and 25,796; 25,797; (Pine Creek specimens); and State University of Iowa, 8,173 (Ames specimen).

Metacoceras perelegans Girty

The Woods Run limestone has yielded relatively few fossils, and Mr. Collins obtained from it only a single cephalopod. This specimen, which is some 65 mm. in diameter, is poorly preserved and is crushed and distorted. However, its general physiognomy and particularly its ornamentation indicate clearly that it belongs in the genus *Metacoceras*, and inasmuch as it possesses both dorsolateral and ventrolateral nodes we are referring it to *M. perelegans*. That species, though not previously recorded from the Woods Run limestone, is fairly abundant in other portions of the Conemaugh of western Pennsylvania, having been found in the Brush Creek, Pine Creek, and Ames limestones.

Occurrence: Woods Run limestone along the Pennsylvania Railroad about a third of a mile southeast of Trafford City, Pennsylvania.

Repository: Carnegie Museum, 25,798.

Tainoceras monilifer Miller, Dunbar, and Condra

For the sake of completeness, it should be mentioned that the collections under consideration contain a fragment of a conch that comes from a locality at which this species was not previously known to occur. This specimen represents part of a whorl some 36 mm. wide. It does not show

either sutures or siphuncle, but it possesses the rows of ventral and ventrolateral nodes that are so characteristic of *Tainoceras*, and all of its characters that can be ascertained seem to coincide well with those of *T. monilifer*, the only representative of the genus known from the Conemaugh.

Occurrence: Ames limestone in "the old brick quarry" at Blackburn, Pennsylvania.

Repository: Carnegie Museum, 25,799.

***Stenopoceras smithi*, sp. nov.**

(Plate II, figures 1, 2)

Two internal molds constitute the basis for this species. Both of them are only moderately well preserved. The conch is subdiscoidal in shape and is fairly large. The larger of the syntypes attains a maximum diameter of about 113 mm., and it is not completely adorally. The whorls, which attain a maximum width just outside the umbilical shoulders, are greatly flattened laterally, almost subangular ventrolaterally, and distinctly concave ventrally—the accompanying illustrations, particularly text figure 1,

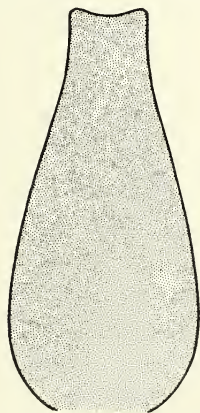


FIG. 1. Diagrammatic cross section of *Stenopoceras smithi*, sp. nov., based on the adoral portion of the phragmacone of the specimen represented by figure 1 on Plate II, $\times 1$.

elucidate the details of their shape. The living chamber appears to be at least two-thirds of a volution in length.

The umbilicus is closed (or nearly so) and is not very conspicuous. The

umbilical shoulders are low and broadly rounded and are, therefore, more or less indefinite.

The surface of the test bears numerous fine growth-lines. These form shallow broadly rounded ventral sinuses, but their course on the other zones of the conch can not be ascertained.

As shown by figure 1 on Plate II, the camerae are short. Each external suture forms a moderately shallow broadly rounded ventral lobe and on either side of it a small subangular ventrolateral saddle, a broad rather deep broadly rounded lateral lobe, a high subangular dorsolateral saddle (on or near the umbilical shoulder), and a rather deep lobe which appears to center on the umbilical seam. The shape of the internal sutures is not known, but almost certainly they do not differ materially from those of other congeneric forms. Neither of the syntypes reveals a trace of the siphuncle.

Remarks: This species is named in honor of Reverend G. H. Smith who collected the only known representatives of it and kindly made them available to us for study. It does not resemble very closely any of the other known congeneric forms except *S. abundum* Miller and Thomas of the Casper formation of Wyoming. These two species are very similar insofar as size, shape (particularly cross section), and ornamentation of the conch are concerned, but the sutures of our species form a relatively high and sharp dorsolateral lobe.

Occurrence: Both of the syntypes came from the Amies limestone near Trimble, Athens County, Ohio. The smaller specimen came from the same block of limestone as the large representative of *Metacoceras cornutum* Girty represented by figures 9 and 10 on Plate I.

Syntypes: State University of Iowa, 8,174.

Bactrites? collinsi, sp. nov.

(Plate I, figures 1, 2)

This species is being based on a single specimen, which represents the adoral camera of the phragmacone and the adapical portion of the living chamber. The conch is straight and is rather gradually expanded orad. In cross section it is subcircular but is very slightly compressed laterally. The overall length of the holotype measures some 30 mm., and at the junction of the phragmacone and the living chamber this specimen is about 39 mm. wide and 41 mm. high.

The test is thin, and its thickness measures distinctly less than half a

millimeter. On the surface of the test there are alternately elevated and depressed low flat transverse bands. The width of these bands is somewhat irregular but seems to average something like a millimeter.

The septa are simple saucer-shaped disks that are moderately convex apicad. The length of the single camera that is preserved measures about 11 mm.—inasmuch as this camera may well be the adoral one of a fully mature or senile individual, its length may not be very significant. The nature of the ventral portion of the sutures is not entirely clear, but on the dorsal and lateral zones of the conch they are straight and directly transverse. The siphuncle is small in size and is ventral and marginal in position, being in contact with the ventral wall of the conch. It appears to be composed of cylindrical segments, and at the adapical end of the holotype is about $2\frac{1}{2}$ mm. in diameter.

Remarks: This species is named in honor of its discoverer, Mr. L. R. Collins. It resembles rather closely *B.?* *cherokeensis* Miller and Owen of the Lower Pennsylvanian of Missouri and *B.?* *mexicanus* Miller of the Middle and Upper Permian of Coahuila. In all three of these forms the conch bears transverse markings, and at least those of the Missouri species (which is also known from only one specimen) are quite similar to those of *B.?* *collinsi*. Although these three species seem to possess all of the features that are generally regarded as characteristic of *Bactrites*, in general physiognomy they do not resemble typical representatives of that genus, for example, *B. subconicus* Sandberger of the Middle Devonian of Germany.

Occurrence: Brush Creek limestone in the Harvey Brick Company Quarry of Glassmere, Pennsylvania.

Holotype: Carnegie Museum, 25,800.

***Pennoceras seamani* Miller and Unklesbay**

(Plate I, figures 3, 4)

This rare species is represented in the Collins collection by four specimens. Only one of these shows its sutures, but the general physiognomy and particularly the prominent transverse lirae of the others are sufficient to indicate their identity.

All four of the specimens under consideration are typical. They coincide well with the specific description we published in 1942, and they substantiate our statements in regard to the various morphological features of

the conch. One individual is particularly well preserved, and we are illustrating it.

Occurrence: Two of the specimens collected by Mr. Collins (including the one figured) came from the Brush Creek limestone in the Harvey Brick Company quarry near Glassmere; a third is from the same formation near the west end of the Sewickley bridge near Sewickley; and the fourth is from the Pine Creek limestone in the Pennsylvania Railroad cut near Witmer, Pennsylvania. The specimen mentioned last is the first one that we have seen from the Pine Creek, though, as we stated in 1942, Raymond's lists of 1910 and 1911 seem to indicate that this species occurs in the Pine Creek as well as in the Brush Creek.

Repository: Carnegie Museum, 25,801 (figured specimen), 25,802 and 25,803 (two unfigured specimens from Brush Creek), and 25,804 (Pine Creek specimen).

REFERENCES

- MILLER, A. K., DUNBAR, C. O., AND CONDRA, G. E.
1933. *The nautiloid cephalopods of the Pennsylvanian system in the Mid-Continent region*: Nebraska Geol. Surv. Bull. 9, 2d ser., pp. 1-240, pls. 1-24.
- MILLER, A. K., AND OWEN, J. B.
1934. *Cherokee nautiloids of the northern Mid-Continent region*: Univ. Iowa Studies Nat. Hist., vol. 16, pp. 185-272, pls. 8-19.
- MILLER, A. K., AND UNKLESBAY, A. G.
1942. *The cephalopod fauna of the Conemaugh series in western Pennsylvania*: Annals, Carnegie Museum, vol. 29, pp. 127-174, pls. 1-8.
- RAYMOND, P. E.
1910. *A preliminary list of the fauna of the Allegheny and Conemaugh series in western Pennsylvania*: Annals, Carnegie Museum, vol. 7, pp. 144-158.
1911. *A preliminary list of the fauna of the Allegheny and Conemaugh series in western Pennsylvania*: Pennsylvania Topog. and Geol. Surv. Comm., Rept. 1908-1910, pp. 81-98, pls. 3-6.

EXPLANATION OF PLATE I

FIGS. 1, 2. *Bactrites? collinsi*, sp. nov.

Lateral and apical (septal) views of the holotype, which came from the Brush Creek limestone near Glassmere, Pennsylvania, $\times 1$.

FIGS. 3, 4. *Pennoceras seamani* Miller and Unklesbay

Two views of a well preserved specimen from the Brush Creek limestone near Glassmere, Pennsylvania, $\times 3$.

FIGS. 5, 6. *Coelogasteroceras dubium*, sp. nov.

Lateral and ventral views of the holotype, which came from the Brush Creek limestone near Glassmere, Pennsylvania, $\times 1$.

FIGS. 7, 8. *Ephippioceras ferratum* (Cox)

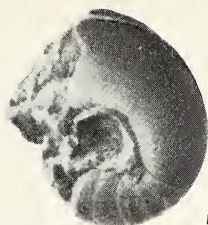
Two views of a well preserved specimen from the Brush Creek limestone near Creighton, Pennsylvania, $\times 1$.

FIGS. 9, 10. *Metacoceras cornutum* Girty

Ventral and lateral views of a moderately large specimen from the Ames limestone near Trimble, Ohio, $\times 1$.



1



5



3



2



7



4



6



9



8



10

EXPLANATION OF PLATE II

FIGS. 1, 2. *Stenopoceras smithi*, sp. nov.

Lateral views of the two syntypes, both of which came from the Ames limestone near Trimble, Athens County, Ohio, $\times 1$ (fig. 1) and $\frac{7}{8}$ (fig. 2).



7.73
496842



ART. XIX. NEW SOUTH AMERICAN PARROTS

By W. E. CLYDE TODD

INTRODUCTION

A study of the Parrots (Family Psittacidae) in the collection of the Carnegie Museum has recently been completed. It shows that we have 1,992 specimens, referable to 203 species and subspecies. Of this total there are 63 forms, represented by 276 specimens, which are from the Old World (mainly Africa and Australasia), and 140 forms and 1,716 specimens are from the New World. In the latter group there are at least six subspecies which appear to be new to science, and which are described and named herewith; one other is described but not named. In order to clarify the relationships of these new races their conspecific relatives have also been discussed from the taxonomic standpoint. In drawing up descriptions the names of colors are in the main those used in Ridgway's "Color Standards and Color Nomenclature." Measurements, where given, are in millimeters, and the length of the bill is that of the chord of the culmen, taken from the cere.

THE RACES OF PYRRHURA MOLINÆ.

Salvadori (1891) considered this species to be homogeneous. A southern race (*australis*) was described by the present writer in 1915, and in 1929 Neumann discriminated a northern race under the name *phœnicura* of Schlegel. But the problem is not so simple as it would thus appear. The series of specimens in the Carnegie Museum (considerably augmented since 1915) splits up into no less than four geographic variants, two of which appear to be undescribed.

Pyrrhura molinæ molinæ (Massena and Souancé).

Seventeen specimens: Cerro Hosáne, Locotal, San José, and Incachaca, Bolivia.

There is nothing in the original description that might serve to fix the name *molinæ* on the form represented by the above specimens. Comparison with the type-specimen in the British Museum would be desirable in order to settle the matter beyond question. However, the chances favor the type

having come from the highlands of Bolivia rather than from the outlying parts of that country, so I feel fairly safe in assigning our specimens to *P. molinæ molinæ*. The examples from Cerro Hosáne, however, are not so richly colored as those from the Cochabamba region; the difference may be seasonal.

Five males in fresh plumage measure: wing, 133-143; tail, 137-149; culmen from cere, 17-18; tarsus, 15-15.5.

***Pyrrhura molinæ sordida*, subsp. nov.**

Eight specimens: Puerto Suarez, Bolivia.

Type, No. 31,318, Collection Carnegie Museum, adult male; Puerto Suarez, eastern Bolivia, December 17, 1908; José Steinbach.

Subspecific characters.—Similar to *P. m. molinæ* of the Bolivian highlands, but somewhat smaller, and general coloration duller; pileum paler brown (olive brown); green area on the sides of the head reduced in extent, and paler (oil green); squamation on the breast indistinct (by reason of the paler centers of the feathers); green of the underparts duller, and the maroon abdominal area paler and less prominent; wings externally paler blue (China blue). Wing (type), 130; tail, 125; culmen from cere, 15; tarsus, 15.

Range.—Southern Matto Grosso, Brazil, to extreme eastern Bolivia.

Remarks.—This bird is apparently the same as that described and figured by Ribeiro, Rev. Mus. Paulista, 12, 1920, 80, pl. 8, fig. 1, except that his figure shows no green color whatever on the sides of the head. Neumann (Nov. Zool., 35, 1929, 217-219) discusses the races of this species, and comments on Ribeiro's paper, but like him he does not venture to name this form, and contents himself with pointing out the application of the name *phænicura* of Schlegel to the bird of northern Matto Grosso. According to Gyldenstolpe (K. Svenska Vet. Handl., 23, No. 1, 1945, 85) *phænicura* differs from both *molinæ* and *australis* "by having the bases of the central rectrices tinged with greenish for about half their basal length." The original description does not mention this feature, and we should like to know whether it is present in Schlegel's type-specimen. The dull coloration of the present race is a marked and constant feature as compared with true *molinæ*. In the latter the wings externally are dusky greenish blue, as they also are in *australis*. The exact range of the new race remains to be worked out, but it is obviously characteristic of the Chaco region of Bolivia, whence it extends into southern Matto Grosso.

***Pyrrhura molinæ restricta*, subsp. nov.**

Four specimens: Palmarito, Bolivia.

Type, No. 80,155, Collection Carnegie Museum, adult female; Palmarito, Rio San Julian, Chiquitos, Bolivia, May 23, 1918; José Steinbach.

Subspecific characters.—Similar to *P. m. molinæ*, but green of cheeks tinged with blue; blue collar on hindneck always prominent; pale feather-edgings of throat and breast wider and much paler in color (more soiled white rather than buffy), almost concealing the pale dusky bases of the feathers; maroon abdominal area reduced and duller-colored; flanks and crissum with a strong bluish cast. Wing (type), 136; tail, 136; culmen from cere, 17; tarsus, 14.

Range.—Known only from the type-locality.

Remarks.—Beyond question the four specimens from this locality represent a form different from all the others. Coming as they do from a locality which has already yielded several other novelties, it is no surprise to find that *Pyrrhura molinæ*, which seems to be a plastic species, appears here in a somewhat different guise. The new race is easily separable from true *molinæ* by the characters above specified; from the Puerto Suarez bird (*sordida*) it may at once be distinguished by its deep blue (dusky greenish blue) wings externally, and by the different color of the squamate markings on the breast, which are grayish white, not buffy.

***Pyrrhura molinæ australis* Todd.**

Eight specimens: Rio Bermejo, Argentina, and Yacuiba, Bolivia.

In describing this new race I compared it directly with birds from Puerto Suarez, Bolivia, which I assumed at the time to represent true *molinæ*, but which I am now satisfied belong to a hitherto unrecognized race of this species. The differences between *australis* and birds from the highlands of Bolivia (which in my opinion are far more likely to be true *molinæ*) are not so impressive; although easy to see when the two respective series lie side by side, they are hard to formulate. However, *australis* averages smaller; the maroon abdominal area is more pronounced; the under tail-coverts are greener, less bluish; and the green of the underparts is duller. The pale feather-edgings of the breast are perhaps a little narrower. The race is recognizable on these grounds.

Compared with *sordida*, the present race differs in decidedly deeper general coloration. The pileum and nape are darker-colored (nearer fuscous than sepia); the sides of the head and neck are correspondingly

darker, less buffy, with the pale feather-edgings narrower, giving a more decidedly squamate general effect; the abdomen is more extensively red, and the color is deeper (Pompeian red instead of dragon's blood red); the green of the underparts is also deeper; and the under tail-coverts are scarcely or not tinged with blue.

At first I thought these differences might be due to season and wear, but I am now convinced that the northern Argentina birds represent a valid race, despite Sclater and Hudson's dictum (Argentine Ornithology, 2, 1880, 43) to the contrary. The greater extent of the abdominal red area in the present race is a well-marked feature. In *sordida* this is merely indicated; the feathers are dull red only at their bases, and more or less tipped with yellowish green, while in the present form these tips are scarcely evident, so that the general effect is more "solid"; the color is also deeper.

THE RACES OF PYRRHURA PICTA.

The latest authority (Peters, 1937) recognizes four races of this species, but the first of these, *subandina*, is in my opinion not conspecific with the others. The series studied in this connection, consisting of 86 specimens, falls into five racial groups, each with a definite geographic range and differential characters of its own. These are as follows:

***Pyrrhura picta picta* (Müller).**

Twenty-six specimens: Tamanoir and Pied Saut, French Guiana; Cayari Island, Brazil.

Some variation obtains in this series; it is mostly seasonal. Specimens from Pied Saut, shot in December and January, are in fine fresh plumage; the feathers of the breast are dusky black basally, with broad margins of buffy or soiled white, inclining to rufescent in some cases. Birds shot from April to July are in various stages of wear, as shown by the condition of the rectrices. In one specimen (61,817) the blue color of the fore crown overspreads the entire pileum. Tail (σ^7), 109-119 mm.

***Pyrrhura picta orinocensis*, subsp. nov.**

Eight specimens: Rio Yuruan, El Peru Mine, and Altagracia, Venezuela.

Type, No. 34,302, Collection Carnegie Museum, adult male; Altagracia, Venezuela, June 7, 1910; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Pyrrhura picta picta* of French Guiana, but pileum paler, olive brown (instead of fuscous); throat- and breast-feathers with the pale margins narrower (the squamation thus less pronounced); and tail averaging shorter.

Range.—Venezuela, from the lower Orinoco Valley to the British Guiana frontier.

Remarks.—Birds from this region have always been referred to typical *picta*, from which, however, they are clearly racially distinct, as shown by a comparison in series. The Venezuelan birds were taken from March to June; although they vary somewhat among themselves, they differ as aforesaid from French Guiana birds comparable as to season. The paler, duller color of the pileum is a constant feature; the squamation of the breast is variable. The blue of the forehead averages paler in the new race, and the ground-color of the breast tends to be green rather than dusky, as it is in *picta*.

So far as I can discover, none of the synonyms of *picta* would apply to the Venezuelan race, so it is necessary to give it a name. The type has been chosen from a locality in the Orinoco Valley.

Wing (type), 119; tail, 108; culmen from cere, 14; tarsus, 11.

***Pyrrhura picta amazonum* Hellmayr.**

Twenty-one specimens: Obidos, Brazil.

Topotypes. This is a strongly marked form, so different from true *picta* that one is tempted to accord it specific rank. In addition to the characters specified by Hellmayr, the breast-feathers are usually green in the center, instead of dusky, as in *picta*. However, in view of the admittedly close relationship between the two, and in deference to current usage, I keep them as conspecies. The squamate markings on the breast are very prominent, and range from buffy to rusty in color.

***Pyrrhura picta microtera*, subsp. nov.**

Seventeen specimens: Santarem, Colonia do Mojuy, and Villa Braga, Brazil.

Type, No. 78,378, Collection Carnegie Museum, adult male; Santarem, Brazil, September 28, 1920; Samuel M. Klages.

Subspecific characters.—Similar to *Pyrrhura picta amazonum* Hellmayr, but smaller; blue color on forehead averaging more restricted; and ground-color of throat- and breast-feathers darker, dusky rather than greenish.

Range.—South bank of the lower Amazon.

Remarks.—Hellmayr described *amazonum* from Obidos, from which we have a satisfactory series of specimens. Later (Nov. Zool., 14, 1907, 36-38), in reviewing the races of this species, he referred his single specimen from Santarem to the same form, and in so doing was followed by Griscom and Greenway (Bull. Mus. Comp. Zool., 88, 1941, 142). Direct comparison of our series from Santarem and the Rio Tapajóz with another from the north bank of the river (topotypes of *amazonum*), however, shows that the former are constantly smaller, and that they differ also in slight details of coloration. In *amazonum* the wing of the male ranges from 119 to 126 mm., and the tail from 106 to 114 mm. In the Santarem series the males run: wing, 108-116 mm.; tail, 88-101 mm. (excluding badly worn specimens in both series). There is thus every justification for giving the south-bank bird a name.

***Pyrrhura picta luciani* (Deville).**

Fourteen specimens: Hyutanahan and Arimã, Brazil.

On the characters and status of this form cf. Gyldenstolpe, K. Svenska Vet. Akad. Handl., 22, No. 3, 1945, 50-52. Our specimens from the Rio Purús agree precisely with his description of specimens from Porto Velho, and they are clearly distinct from *roseifrons* of the upper Rio Juruá and the upper Amazon. *P. p. luciani* has the blue frontlet on the crown very narrow or wanting, while the feathers of the lower breast are strongly centered with green. This form, the type-locality of which Hellmayr (Arch. f. Naturg., 85, Abt. A, 1920, 127) has determined to be Ega (= Teffé), on the Rio Solimoës, ranges from the Rio Purús to the Rio Madeira; it is found on both banks of the latter stream, and may extend still farther east.

PYRRHURA SUBANDINA, A VALID SPECIES.

Pyrrhura subandina was described by the present writer some years ago (Proc. Biol. Soc. Washington, 30, 1917, 6) on the basis of three specimens from Jaraquiel, Bolivar, Colombia, which had been compared with specimens of "immature *Pyrrhura luciani*" in the U. S. National Museum by Dr. Harry C. Oberholser. The diagnosis as published was adapted from Dr. Oberholser's report on his findings. In the meantime our conception of the status of *P. luciani* has altered somewhat, so that it becomes desirable to present a fuller description of *P. subandina*.

Description.—Above, including secondaries externally and wing-coverts,

bright parrot green; rump and median upper tail-coverts garnet brown; primaries externally Paris blue, with black tips and wide black inner margins, and narrow pale green outer margins; outermost primary entirely black; tail dark red (between garnet brown and maroon), with the feathers extensively green on their outer webs towards the base; pileum and nape dark brown (near bister), succeeded by an ill-defined band of Jouvence blue; lores and a narrow frontlet garnet brown; cheeks dark Russian green; ear-coverts dull ochraceous tawny; throat and breast with broadly squamate markings of soiled buff, the feathers with dusky centers; rest of underparts (including under wing-coverts) bright parrot green with a slight bluish shade, the middle of the abdomen extensively garnet brown; "iris straw-color; bill and feet blackish" (Carriker).

Measurements.—Two males: wing, 114, 116; tail, 112, 112; culmen from cere, 15, 14; tarsus, 12, 12. Female (same order), 115, 111, 15, 12.

Range.—Rio Sinu region of northwestern Colombia.

Remarks.—This *Pyrrhura* is completely isolated by the interposition of the Andes from *P. picta luciani*, and its differential characters are such that in my opinion it ought to stand alone. Since birds from the Eastern Andes prove to belong to a closely allied but recognizably distinct race, a trinomial name will now be necessary.

***Pyrrhura subandina cæruleiceps*, subsp. nov.**

Two specimens: El Cauca, Colombia.

Type, No. 54,728, Collection Carnegie Museum, adult male; El Cauca, Colombia, August 2, 1916; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Pyrrhura subandina subandina* nobis of the Rio Sinu region of Colombia, but entire pileum dull blue (porcelain blue), with the nape more dusky; lores, cheeks, and circumocular region garnet brown; and throat and breast with the feather-edgings broader and paler soiled white. Size the same: wing (type), 119; tail, 104; bill, 15; tarsus, 12.

Range.—Known only from the type-locality, on the western slope of the Eastern Andes of Colombia.

Remarks.—This is a strongly marked form, and although it is represented by only a single pair of specimens, I do not hesitate to describe it as new. The discovery of two representative forms of the *Pyrrhura picta* group in Colombia west of the Andes is of unusual interest. The comparative rarity of the bird is attested by the fact that thus far no other collector has secured specimens.

AN APPARENTLY NEW RACE OF *FORPUS CONSPICILLATUS*.

Seven specimens: Palmar, Colombia.

Three males and four females from this locality, at the eastern base of the Eastern Andes, are scarcely referable to true *conspicillatus*. The males differ in the shade of blue on the wings and rump; it is spectrum blue instead of Hay's blue; and also in having the blue of the circumocular region reduced to a mere trace. On the other hand, they can scarcely be referred to the western Colombian race, *caucaæ*, since they are not quite large enough, although agreeing in color; moreover, this would involve a discontinuous distribution for *caucaæ*. On the whole, it would seem best to regard the above birds as representing a slightly differentiated subspecies, but more specimens are needed to demonstrate the constancy of its characters, so that I do not venture at present to give it a name.

A NEW RACE OF *PIONUS SORDIDUS*.***Pionus sordidus antelius***, subsp. nov.

Three specimens: San Rafael, Venezuela.

Type, No. 106,682, Collection Carnegie Museum, adult male; San Rafael, Venezuela, November 19, 1929; Harold J. Clement.

Subspecific characters.—Similar to *Pionus sordidus sordidus* of the Caracas region of Venezuela, but general coloration paler and more yellowish green; throat green with little or no bluish tinge; breast without any purplish pink suffusion; and rest of underparts dark citrine, with paler (sulphine yellow) edges to the feathers; slightly smaller also.

Measurements.—Two males: wing, 163, 165; tail, 73, 74; culmen from cere, 25, 26; tarsus, 18, 18. Female (same order): 158, 72, 24, 18.

Range.—Presumably the Subtropical Zone, eastern part of the Coast Range, south of Cumanacoa, Venezuela.

Remarks.—This very distinct race varies from true *sordidus* (restricted type-locality, Caracas) in a different direction from *saturatus* of the Santa Marta region. While it retains the broad, pale feather-edgings which are so prominent a feature in *sordidus*, the color is entirely different, more yellowish green in tone. The color of the throat is vivid green (of Ridgway), with a slight dash of blue on the chin in one specimen; there is an entire lack of vinaceous pink feather-edgings on the breast, as in *sordidus*. The upperparts of the two respective races are more nearly alike.

07.73
AP6842



ART. XX. A REVIEW OF THE GASTEROMYCETES
(FUNGI) OF WESTERN PENNSYLVANIA

By LEROY K. HENRY

(PLATES I-IV)

The Gasteromycetes belong to that class of basidiomycetes which bear their spores in cavities or chambers within the tissues of the plant. The peridium is the shell which encloses the spore mass. It usually consists of two layers, but may be a single layer as in the genus *Scleroderma*. This outer layer of the peridium may be thick and leathery as in the genus *Geaster*; thin and friable and bearing spines or warts as in the genus *Lycoperdon*; or thick and gelatinous as in the phalloids. A true stalk or stem is absent except in two tribes which are not represented in our region, but the base of the peridium is often contracted into a stalk-like portion in many genera.

The whole fleshy mass of soft cellular structure inside the immature fruiting-body is called the gleba. At first it is a cellular mass which, as the plant grows, develops into a tissue of minute chambers. The interior walls of these chambers are lined with a spore-bearing layer. In the *Nidulariales* the walls of the glebal chambers thicken and each chamber becomes a separate, little seed-like structure enclosing the spores, known as a peridiole.

When the fruiting-body reaches full size, the tissues of the glebal chambers deliquesce, become moist, discolored and are absorbed and disappear. Finally the moisture dries up leaving the peridium filled with a dry, dusty mass, usually consisting of slender threads, the capillitium, and of multitudes of ripe spores, the spore mass.

This review is based upon the specimens in the Herbarium of the Carnegie Museum which have been collected in Western Pennsylvania.

As the eastern boundary of Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon and Fulton Counties. The initials following the collection data are to be interpreted as follows: L.K.H.—L. K. Henry; O.E.J.—O. E. Jennings; D.R.S.—D. R. Sumstine; M.B.K.—Marie B. Knauz; H.S.W.—H. S. Wieand. The numerals following the author's initials are his field numbers.

KEY TO GASTEROMYCETES

- I. Fruiting-body usually without marked odor; gleba not apical or slimy. II.
- I. Fruiting-body usually with a strong, disagreeable odor; globose or egg-shaped when young, inclosed in a thick peridium which remains as a cup at the base; gleba slimy at maturity. *Phallales*
- II. Fruiting-body fleshy or fleshy-tough when young; subglobose to top-shaped; gleba dry and dusty or powdery at maturity. *Lycoperdales*
- II. Fruiting-body with or without a sterile base; gleba with or without chambers, in a few cases dividing up into minute peridioles, finally becoming a dusty or powdery mass; capillitium none or rudimentary or well developed. *Sclerodermatales*
- II. Fruiting-body globose to cup-shaped or vase-shaped, open at maturity; gleba waxy; chambers with distinct wall forming peridioles within which egg-like structures the spores are borne; capillitium wanting. *Nidulariales*

PHALLALES

- I. Fruiting—body elongated or pear-shaped. *Clathraceae*
 - A. Gleba borne on the inner surface of the three arm-like structures which are arched outward and united at their tips and attached at base to a short stalk. *Colus Schellenbergiae*
 - A. Gleba borne on the inner surface of the six, hollow arm-like structures, borne at the end of a relatively long stalk. *Anthurus borealis*
 - A. Gleba borne on the inner surface of irregularly shaped lobes, developed by breaking open of the pear-shaped fruiting-body. *Phyllogaster saccatus*
- I. Fruiting-body consisting of a hollow, spongy stem with a basal volva and an apical portion bearing the gleba externally. *Phallaceae*
 - A. Gleba borne on the outside of a cap-like structure at the end of a stem.
 - B. Stem with a more or less prominent, net-like veil and a membranous veil. *Dictyophora duplicata*
 - B. Stem with a single, membranous veil. *Ithyphallus*
 - C. Outer surface of cap strongly pitted. *I. impudicus*
 - C. Outer surface of cap minutely granular. *I. Ravenelii*
 - A. Gleba borne on the naked apex of the stem. *Mutinus*
 - B. Stem 10–17 cm. long, spore-bearing part undifferentiated. *M. Curtisii*
 - B. Stem 6–8 cm. long, spore-bearing part sharply differentiated. *M. Ravenelii*

LYCOPERDALES

- I. Peridium with a distinct outer coat, falling away in flakes or wearing away slowly or splitting into rays; gleba composed of hollow chambers lined with the hymenium; spores mixed with a capillitium (slender branched or unbranched threads) and escaping usually through a definite pore *Lycoperdaceae*
- A. Outer peridium thin, lead-color to reddish-brown, peeling off in flakes; inner peridium opening by a pore; mature plant loosened from place of growth and blown about by wind. *Bovista*
- B. Fruiting-body moderate to large in size, above the ground; pedicel short. *B. pila*
- B. Fruiting-body subterranean until exposed by the weather; pedicel long and wavy. *B. minor*
- A. Outer peridium thick or thin, scaling off in flakes or more or less persistent; inner peridium collapsing or breaking up as the spores ripen; mature plants normally remain attached to place of growth.
- B. Capillitium of separate threads with slender branched fruiting-body yellowish-brown with a sterile base. *Bovistella radicata*
- B. Capillitium of long interwoven threads; outer peridium composed of scales, spines, warts or granules; inner peridium membranous to papery, usually opening by an apical mouth at maturity; fruiting-body less than 8 cm. in diameter. *Lycoperdon*
- C. Mature spore-mass with a purplish tint.
- D. Outer peridium composed of hair-like spicules about 1 mm. in length, usually free at their apices; inner peridium furfuraceous. *L. atropurpureum*
- D. Outer peridium composed of spines, white or pale brown, 2-3 mm. long, convergent at their apices; inner peridium smooth and shining. *L. pulcherrimum*
- D. Outer peridium a smooth continuous layer which breaks up into thin scales and areolations at maturity. *L. rimulatum*
- D. Outer peridium scurfy or granular, at times mixed with fine spines. *L. umbrinum*
- C. Mature spore mass yellowish-brown to greenish-brown.
- D. Sterile base prominent, occupying one-third or more of the fruiting-body.
- E. Sterile portion white; mycelium white, cord-like; outer peridium of reddish-brown persistent granules; on rotted wood. *L. pyriforme*
- E. Sterile portion yellowish; outer peridium of separate spines intermingled with deciduous warts; inner peridium reticulated. *L. gemmatum*
- D. Sterile base small or entirely wanting.
- E. Sterile portion occasionally large, yellowish; outer peridium of short, sharp spines which peel off in flakes at maturity; inner peridium dull and furfuraceous. *L. marginatum*

- E. Outer peridium of pinkish-brown warts or spines; inner peridium pitted; on rotted wood. *L. subincarnatum*
- E. Outer peridium of stout spines up to 1 mm. long, rather pale, convergent (single or grouped); inner peridium smooth; spores with long, persistent pedicels. *L. pedicellatum*
- E. Outer peridium same, but spines dark to deep brown at maturity; spores with short pedicels. *L. eximium*
- E. Outer peridium of minute bran-like scales persistent upon the pale brown surface of the inner peridium; fruiting-body small, usually under 2 cm. thick. *L. pusillum*
- E. Outer peridium golden yellow dotted with minute warts or nodules which during maturity become dark brown.
L. coloratum
- B. Capillitium of long interwoven threads which may break up into short pieces; outer peridium thin, usually smooth or areolated; inner peridium thin and fragile; irregularly ruptured by falling away in scales and plates; fruiting-body usually over 8 cm. in diameter. *Calvatia*
- C. Spore mass violet to purple.
 - D. Fruiting-body 7-18 cm. in diameter; sterile base thick, cup-shaped after spore mass breaks away. *C. cyathiformis*
 - C. Spore mass yellowish-orange to greenish-brown.
 - D. Sterile base scanty or lacking; fruiting-body globose to subglobose, usually more than 15 cm. in diameter; gleba greenish-brown. *C. maxima*
 - D. Sterile base same; fruiting-body subglobose to turbinate, usually less than 10 cm. in diameter; gleba yellowish to brownish-orange.
C. rubro-flava
 - D. Sterile base short and thick; outer peridium of thick, floccose warts or spines; capillitium threads much thicker than the spores.
C. caelata
 - D. Sterile base same; outer peridium thin, smooth; capillitium threads about as thick as the spores. *C. craniiformis*
- A. Outer peridium thick, splitting at maturity into star-like rays from above downward and remaining attached to the inner peridium by their united bases; inner peridium with a single, apical mouth. *Geaster*
- B. Outer peridium saccate, not hygroscopic; inner peridium sessile; mouth definite, usually surrounded by a circular area.
 - C. Fleshy layer of outer peridium thick, usually breaking circumscissally near the middle and remaining as a free margined cup at the base of the inner peridium; expanded plant measuring 8-12 cm. across. *G. triplex*
(Specimens lacking the cup and smaller in size are considered as forms, formerly called *G. lageniformis* Morg.)
 - C. Fleshy layer of outer peridium thin, adnate, not breaking circumscissally.

- D. Outer layer of outer peridium thin, adnate, glabrous (definite circular mouth is lacking in some forms.).....*G. Saccatus*
- D. Outer layer of outer peridium thick and felted-tomentose, partially separating from the middle layer; expanded plant measuring 3-4 cm.....*G. velutinus*
- D. Outer layer of outer peridium thick and strigose-tomentose; plants caespitose, up to 2.5 cm. broad when expanded, forming mycelial mats.....*G. mirabilis*

SCLERODERMATALES

- I. Peridium thick, sessile without a distinct, separate outer layer, usually warted or scaly; gleba breaking up into solid peridioles in one genus; capillitium rudimentary or none; sterile base often present..... *Sclerodermataceae*
 - A. Fruiting-body globose, sessile; peridium a single layer, usually thick, tough and hard, or thin and leathery; warted, granular or nearly smooth; mouth irregular to stellate; gleba white at first, becoming greenish to purplish-brown; capillitium none or rudimentary.....*Scleroderma*
 - B. Peridium yellowish, nearly smooth or areolated; spores strongly reticulated.....*S. bovista*
 - B. Peridium light-brown or yellowish-brown, very thin, covered with minute dark-brown, inherent scales.....*S. lycoperdoides*
 - B. Peridium ochraceous or brownish, thick when fresh, thinner when dry, surface cracked into distinct, inherent scales, 1-3 mm. wide, which are with or without a stout central wart.....*S. aurantium*
- II. Peridium with a distinct outer layer which at maturity splits into star-like segments, exposing the persistent inner peridium.....*Astraeaceae*
 - A. Unexpanded form embedded in the soil, depressed-globose to ovate; outer peridium thick, dark brown, composed of four layers, strongly hygroscopic, splitting radially into 7-20 acute segments which are expanded when moist and incurved over inner peridium when dry; inner peridium tough or leathery, gray or light-brown, scurfy, sessile; mouth definite but irregular; gleba reddish-brown; capillitium threads branched.*Astraeus hygrometricus*
- III. Outer peridium gelatinous, spongy or fibrous breaking up into scales at maturity; inner peridium composed of two layers enclosing the gleba; stem consisting of anastomosing, gelatinous, hyphal strands..... *Calostomataceae*
 - A. Sporebearing portion of fruiting-body globose, borne on a gelatinous stem; outer peridium composed of two layers; the outer one thick and usually gelatinous, the inner one thin and cartilaginous; inner peridium hard and cartilaginous when dry, dehiscing by means of a raised, stellately rayed, red, mouth; gleba white to yellowish-white, enclosed by a cream-colored or yellow membrane; capillitium scanty, fragile.....*Calostoma*
 - B. Outer peridium scaling off entirely, the outer layer forming a thick, soft jelly; the entire inner layer of outer peridium and the outer surface of the inner peridium bright red when fresh.....*C. cinnabarina*

- B. Outer peridium composed of a gelatinous outer layer and a pale yellow, corky, inner layer, not scaling off completely but remaining as a collar around the base of the inner peridium; red color confined to the mouth region. *C. lutescens*
- B. Outer peridium spongy but not gelatinous, its inner layer remaining as persistent scales on the surface of the inner peridium; red color confined to the mouth region. *C. ravenelii*

NIDULARIALES

- I. Fruiting-body very small, peridium composed of four layers, dehiscing stellately; gleba fleshy, forming a single peridiole-like structure which is violently ejected at maturity. *Sphaerobolaceae*
 - A. Fruiting-body sessile, globose, minute, 1.5-3 mm. broad, on decayed wood, or entirely embedded in the substratum or the dense white mycelial mat (which often covers the substratum); peridium cream colored or yellowish at first brownish in age; gleba globose, peridiol-like, viscid, about 1 mm. in diameter, cream or buff-colored, becoming reddish-brown with age.
 - Sphaerobolus stellatus*
- II. Fruiting-body cup-shaped or vase-shaped, tough and leathery; peridium consisting of one to three layers; glebal chambers here called peridioles, remaining attached or free within the outer peridium. *Nidulariaceae*
 - A. Peridioles mostly attached by elastic cords to the cups; fruiting-body sessile, cup-shaped or bell-shaped, on twigs and trash in general; peridium composed of a single, thick layer, velvety-tomentose at first, becoming almost smooth in age; inside of cup covered with a thick soft veil which disappears at maturity; peridioles numerous, white, disc-like.
 - Crucibulum vulgare*
 - A. Peridioles mostly attached by elastic cords to the cups; fruiting-body cylindrical, becoming bell-shaped or goblet-shaped; peridium composed of three layers; the outer shaggy, tomentose or glabrous; the middle fibrous; and the inner membranaceous, smooth or striate; veil present at first; peridioles few, disc-shaped, dark brown or black. *Cyathus*
 - B. Inner layer of peridium striate. *C. striatus*
 - B. Inner layer of peridium not striate; outer surface of peridium shaggy with matted woolly hairs. *C. stercoreus*
 - A. Peridioles not attached by cords, but embedded when fresh in a mucus; fruiting-body globose, sessile; peridium (covering the entire fruiting-body and breaking away irregularly at maturity) fragile; cinnamon-brown, tomentose, of a single layer; veil lacking; peridioles dark to reddish-brown.
 - Nidularia pulvinata*

ENUMERATION OF SPECIES

Anthurus borealis Burt. (Plate I)

Allegheny County: near Swissvale, Dr. Cruikshank; Middle Road, Glenshaw, Marie Luckenbacher; $\frac{1}{2}$ mi. west of Riverview Park, N.S. Pittsburgh, P. E. Raymond; near Dormont, H. W. Graham; Board of Education lawn, Pittsburgh, D.R.S.; *Somerset County*: 3 mi. west of Bakersville. C. M. Hepner. *Westmoreland County*: 7 mi. N.E. of Greensburg, R. Boggs.

Colus Shellenbergiae Sumstine

Allegheny County: Pittsburgh, D.R.S., July, 1915. One collection and only record in northern hemisphere.

Phyllogaster saccatus Morgan

Allegheny County: Sandy Creek, D.R.S.; Guyasuta Hollow near Aspinwall, D.R.S.; Vicinity of Warden Mine, L.K.H., 3359; $\frac{1}{2}$ mi. S. of Smithdale, L.K.H., 3336. *Westmoreland County*: Loyalhanna Creek, 2 mi. S. of Saltsburg, L.K.H., 4123; near Latrobe, D.R.S.

Dictyophora duplicata (Bosc.) E. Fischer (Plate II, figs 1, 2)

Allegheny County: Avalon, L.K.H., 1766; West End Park, N. McCallum; Schenley Park, O.E.J.; Ben Avon, Mrs. A. B. Lord; Turtle Creek, D.R.S.; Sandy Creek, D.R.S.; Warden Mine region opposite Sutersville, H. Roslund. *Armstrong County*: Kittanning, D.R.S. *Butler County*: near Zelienople, D.R.S. *Indiana County*: 10 mi. from Indiana, R. W. Wehrle. *McKean County*: Smithport, O.E.J. *Westmoreland County*: 6 mi. S.E. of New Florence, J. A. Shafer.

Ithyphallus impudicus (L.) Fr. (Plate II, fig 3)

Allegheny County: N. of Oakmont, O.E.J.; Glenshaw, L.K.H., 3020. *Armstrong County*: Kittanning, D.R.S. *Clarion County*: Cooksburg, D.R.S.

Ithyphallus Ravenelii (B. & C.) E. Fischer

Somerset County: Kooser State Park, D.R.S. *Potter County*: Carter Camp, 7 mi. W. of Germania, Mrs. Paul Wible. *Venango County*: near Lisbon, H.S.W. *Westmoreland County*: Kiski Campus near Saltsburg, D.R.S.

Mutinus Ravenelii (B. & C.) E. Fischer (Plate II, fig. 4)

Allegheny County: Frick Park, Pittsburgh; Ingomar district; Allegheny Cemetery, Pittsburgh; Warden Mine region opposite Sutersville; near Glenshaw; Crafton; 4 mi. E. of Monongahela. *Armstrong County*: Kittanning. *Beaver County*: Beaver Falls. *Butler County*: 4 mi. N.E. of Har-

mony. *Erie County*: Corry. *Fayette County*: Ohiopyle. *Indiana County*: Glen Campbell. *Westmoreland County*: near Rector; Shades Ravine, 2 mi. E. of Trafford; near Latrobe; along Conemaugh River across from Saltsburg; 1 mi. E. of Mount Pleasant.

Mutinus Curtisii (Berk) E. Fischer

Allegheny County: Schenley Park, Pittsburgh, D.R.S.; Mount Lebanon, Mr. Carson. *Armstrong County*: Kittanning, D.R.S. *Venango County*: along Route 38, S. of Emlenton, M.B.K.

Bovista pila B. & C. (Plate II, fig. 5)

Allegheny County: Saunders Station, E. of Trafford; near Aspinwall; Warden Mine region, opposite Sutersville; near Harmarville; 4 mi. E. of Monongahela City. *Beaver County*: 2 mi. above the mouth of Raccoon Creek. *Crawford County*: Pymatuning Swamp, Hartstown. *Lawrence County*: near New Wilmington. *Washington County*: mouth of Mingo Creek, at Riverview. *Westmoreland County*: Laurel Hill Mountain, 1 mi. N.E. of Laurel Summit; Hillside; Shades Ravine, 2 mi. E. of Trafford; Loyalhanna Creek, 2 mi. S. of Saltsburg.

Bovista minor Morgan

Westmoreland County: 6 mi. S.E. of New Florence, D.R.S.

Bovistella radicata (Mont.) Pat.

Armstrong County: Kittanning, Amy Neale. *Butler County*: Plains Church, 5 mi. S. of Evans City, O.E.J. *Somerset County*: 3 mi. W. of Bakersville, C. M. Hepner.

Calvatia cyathiformis (Bosc.) Morgan (Plate III, fig. 1)

Allegheny County: Wilkinsburg; Bellevue Reservoir; Oakland district, Pittsburgh; Frick Park, Pittsburgh; 4 mi. E. of Monongahela; Turtle Creek; Dormont; near Carnot; 2 mi. E. of Ambridge; Coraopolis; Tom's Run at Dixmont. *Armstrong County*: Kittanning. *Beaver County*: Legionville Hollow near Economy. *Bedford County*: Sulphur Springs. *Butler County*: 4 mi. N.E. of Harmony. *Centre County*: Game Lands No. 33, 3 mi. S.E. of Philipsburg. *Clarion County*: Cook Forest. *Fayette County*: Ohiopyle. *Indiana County*: Rochester Mills. *Mercer County*: 5½ mi. N.E. of Grove City. *Potter County*: Carter Camp, 7 mi. W. of Germania. *Washington County*: near Library. *Westmoreland County*: Idlewild Park, near Ligonier.

***Calvatia craniiformis* (Schw.) Fr.**

Allegheny County: Culmerville; Tom's Run above Dixmont; near Bakerstown; 4 mi. E. of Monongahela; Powers Run, opposite Verona; West of Imperial; Logan's Ferry; near Ingomar; Schenley Park, Pittsburgh; Glenshaw; Ben Avon; Harmarsville; near Perrysville; 1 mi. out Audubon Road from Magee Road; Stewart's Stop, on Charleroi Electric Line. *Armstrong County*: Kittanning. *Butler County*: 4 mi. N.E. of Harmony; near Culmerville; along Route 528, $\frac{1}{4}$ mi. S.E. of junction with Route 8; Little Buffalo Creek at Monroe Station. *Clarion County*: N. of New Bethlehem; Cook Forest. *Greene County*: Roberts Run, 1 mi. S. of Spraggs. *Mercer County*: near West Middlesex. *Venango County*: 1 mi. N. of Lisbon. *Washington County*: vicinity of Houston; Buffalo Creek, near junction with Buck Run; $1\frac{1}{2}$ mi. N.E. of Burgettstown; Raccoon Creek, 2 mi. above Murdocksville. *Westmoreland County*: Congruity, 4 mi. E. of Delmont on Route 22; Kiski Campus, near Saltsburg; Shades Ravine, 2 mi. N.E. of Trafford; along Conemaugh River across from Saltsburg; $2\frac{1}{2}$ mi. N. of Bolivar; Loyalhanna Creek, 2 mi. S. of Saltsburg.

***Calvatia maxima* (Schaeff) Morgan**

Allegheny County: Schenley Park, Pittsburgh, R. J. Templeton. *Washington County*: Eastern part of County, Mrs. Coun. *Westmoreland County*: near Wild Life Lodge, New Kensington, Dr. G. J. Lamon.

***Calvatia caelata* (Bull.) Morgan**

Allegheny County: Schenley Park, Pittsburgh, O.E.J.

***Calvatia rubro-flava* (Lloyd) Cragin**

Armstrong County: Kittanning, Amy Neale.

***Geaster saccatus* Fr.**

Allegheny County: 1 mi. N.E. of Ben Avon Heights, L.K.H., 3006. *Armstrong County*: Kittanning, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, L.K.H., 2160. *Erie County*: Mercyhurst College, S. of Erie, Mary P. Wilbert. *Fayette County*: Ohiopyle, O.E.J. *Washington County*: Finleyville, O.E.J.; New Eagle, O.E.J.; 2 mi. above Murdocksville, along Raccoon Creek, L.K.H., 5369. *Westmoreland County*: Loyalhanna Creek, 2 mi. S. of Saltsburg, L.K.H., 4172; Shades Ravine, 2 mi. E. of Trafford, M.B.K.; Mellon Estate, 6 mi. S.E. of New Florence, O.E.J.

***Geaster mirabilis* Mont**

Allegheny County: 4 mi. E. of Monongahela, C. M. Hepner; Warden

Mine region, opposite Sutersville, H. Roslund. *Washington County*: Distillery Stop at New Eagle, L.K.H., 5178.

***Geaster velutinus* Morgan**

Allegheny County: Warden Mine region, opposite Sutersville, H. Roslund.

***Geaster triplex* Jungh. (Plate III, fig. 2)**

Allegheny County: Warden Mine region, opposite Sutersville; Groveton; Sewickley; 4 mi. E. of Monongahela; along Bessemer R.R. at Rural Ridge; R.R. ties, along Ohio River, N.S. Pittsburgh. *Armstrong County*: West Winfield, along Buffalo Creek, Kittanning. *Beaver County*: Raccoon Creek, 4 mi. W. of Clinton on Route 30. *Butler County*: Stone House on Route 8, 2 mi. N. of Muddy Creek Crossing. *Cameron County*: along Route 872, 10 mi. N.E. of Sinnemahoning. *Clarion County*: Cook Forest. *Erie County*: Presque Isle. *Washington County*: Raccoon Creek, 2 mi. above Murdocksville; vicinity of Houston; 1¼ mi. N.E. of Burgettstown. *Westmoreland County*: Loyalhanna Creek, 2 mi. S. of Saltsburg.

***Lycoperdon coloratum* Peck**

Fayette County: Ohiopyle, L.K.H., 2801, 6/24/39.

***Lycoperdon eximium* Morgan**

Clearfield County: Game Lands No. 34, S. of Medix Run, L.K.H., 3450. *Somerset County*: near Buckstown, O.E.J.

***Lycoperdon atropurpureum* Vitt.**

Butler County: Winfield Junction, Miss Turner. *Erie County*: Presque Isle, C. K. Henlen. *McKean County*: Mt. Jewett, O.E.J. *Westmoreland County*: Hillside, O.E.J.

***Lycoperdon marginatum* Vitt. (Plate III, fig. 3)**

Allegheny County: Sandy Creek; Schenley Park, Pittsburgh; Frick Park, Pittsburgh; 4 mi. E. of Monongahela; Turtle Creek. *Armstrong County*: Kittanning. *Butler County*: 4 mi. N.E. of Harmony; near Culmerville. *Centre County*: Game Lands No. 33, 3 mi. S.E. of Philipsburg; near Rebersburg. *Clarion County*: near Clarion; 4 mi. N.E. of Parkers Landing. *Clearfield County*: Game Lands No. 34, S. of Medix Run. *Erie County*: Presque Isle. *Somerset County*: Laurel Hill near Trent. *Venango County*: near Cooperstown. *Warren County*: S.E. edge of Tamarack Swamp, 2 mi. N.W. of Pine Valley. *Westmoreland County*: Jones Mills; 6 mi. S.E. of New Florence.

***Lycoperdon gemmatum* Batsch. (Plate III, fig. 4)**

Allegheny County: North Park; along Route 910, 3 mi. S.E. of Bakers-town; Frick Park, Pittsburgh; Schenley Park, Pittsburgh; Power's Run, opposite Verona; Big Sewickley Creek, 2 mi. E. of Ambridge; Thompson Run Road, N. of Millvale; 2 mi. E. of Upper Talley Cavey; Valencia; 1 mi. out Audubon Road from Magee Road; near Verona; near Aspinwall; Fallen Timber Hollow, opposite Sutersville; Glenshaw; near Wildwood; Harmarville; 2 mi. W. of Shousetown; Black's Run, N. of Oakmont; Bellevue Reservoir. *Armstrong County*: Kittanning; near Leechburg. *Beaver County*: 1 mi. N.W. of Aliquippa. *Bedford County*: Morrison Cove region, 7 mi. N.E. of Everett. *Butler County*: near Butler; along Route 528, $\frac{1}{4}$ mi. S.E. of junction with Route 8; near Culmerville; 1 mi. S.E. of Whitestown; 4 mi. N.E. of Harmony; near Saxonburg; near Slippery Rock; Little Buffalo Creek at Monroe Station; Croll's Mills on Slippery Rock Creek, N. of West Liberty; Watson's Run, 2 mi. S. of Leasuresville; Muddy Creek Falls at junction with Slippery Rock Creek; Plains Church, S. of Evans City. *Cameron County*: along Route 120, 1 mi. W. of Sinnemahoning. *Centre County*: Pennsylvania State College Campus. *Clarion County*: New Bethlehem; Cook Forest. *Clearfield County*: along Parker Dam Road near C C C Camp; Game Lands No. 34, S. of Medix Run. *Crawford County*: near Hartstown. *Elk County*: Medix Run; near Kane. *Erie County*: near Corry; Presque Isle. *Fayette County*: Ohiopyle; Claircrest. *McKean County*: near Cyclone. *Potter County*: Carter Camp, 7 mi. W. of Germania. *Somerset County*: 3 mi. W. of Bakersville; 2 mi. E. of Berlin; $\frac{1}{2}$ mi. N.E. of Pleasant Union; Laurel Hill Mountain, near Trent. *Venango County*: 3 mi. N. of Emlenton, at Goeries Mills; 3 mi. N.E. of Emlenton; 1 mi. N. of Lisbon. *Washington County*: Finleyville; along Buffalo Creek near junction with Buck Run; Raccoon Creek, 2 mi. S. of Murdocksville; vicinity of Houston; Distillery Stop at New Eagle. *Westmoreland County*: Kiski Campus, near Saltsburg; Linn Run, 3 mi. S.E. of Rector; Loyalhanna Creek, 2 mi. S. of Saltsburg; Idlewild Park near Ligonier; Congruity, 4 mi. E. of Delmont on Route 22; 6 mi. S.E. of New Florence; 2 mi. S.E. of Laughlintown; near Waterford; 1 mi. E. of Kregar; Jones Mills; along Conemaugh River opposite Saltsburg; Shades Ravine, 2 mi. E. of Trafford; 1 mi. E. of Mount Pleasant; Hillside.

***Lycoperdon pusillum* Batsch.**

Allegheny County: the Pines on Route 19, 1 mi. N. of Perrysville, D.R.S.
Butler County: 4 mi. N.E. of Harmony, L.K.H., 1174.

***Lycoperdon pulcherrimum* B. & C.**

Allegheny County: Frick Park, Pittsburgh, L.K.H., 158. *Beaver County*: Temple Hollow behind Aliquippa, L.K.H., 2913; Raccoon Creek, 2½ mi. S.E. of New Sheffield, L.K.H., 4552. *Westmoreland County*: Hillside, O.E.J.

***Lycoperdon pedicellatum* Peck**

Allegheny County: Powers Run, opposite Verona, O.E.J. *Bedford County*: Sulphur Springs, O.E.J. *Butler County*: Watson's Run, 2 mi. S. of Leasurville, L.K.H., 1655; woods along Route 528, ¼ mi. S.E. of Junction with Route 8; L.K.H., 4284; tributary of Crab Run, 4 mi. N.E. of Harmony, L.K.H., 4373. *Venango County*: 3 mi. N.E. of Emlenton, L.K.H., 5448. *Westmoreland County*: Idlewild Park, near Ligonier, D.R.S.; 6 mi. S.E. of Florence, D.R.S.; Linn Run, 3 mi. S.E. of Rector, O.E.J.

***Lycoperdon pyriforme* Schaeff.**

Allegheny County: Schenley Park, Pittsburgh; near Wildwood; Frick Park, Pittsburgh; Powers Run, opposite Verona; Beadling; Allison Park; near Bakerstown; Narrows Run, near Stoops Ferry; Fallen Timber Hollow, opposite Sutersville; Black's Run Ravine, N. of Oakmont; 4 mi. E. of Monongahela; 2 mi. E. of Upper Talley Cavey (on Route 8 at Wildwood Road); along Route 910, 3 mi. S.E. of Bakerstown. *Armstrong County*: Kittanning. *Beaver County*: near Beaver. *Blair County*: Tyrone. *Butler County*: Valencia; near Butler; 4 mi. N.E. of Harmony; near Zelienople; near Saxonburg; Little Buffalo Creek, near Monroe Station; 1 mi. S.E. of Whitestown. *Cambria County*: Ebensburg. *Clarion County*: Cook Forest. *Clearfield County*: State Game Lands No. 34, S. of Medix Run. *Erie County*: Corry. *Fayette County*: Ohiopyle. *Forest County*: Cook Forest. *Huntingdon County*: near Birmingham. *Indiana County*: near Indiana. *Lawrence County*: woods at mouth of Muddy Creek. *Somerset County*: Buckstown; along Route 31, 2 mi. W. of Kooser State Park. *Venango County*: 3 mi. N.E. of Emlenton. *Washington County*: Buffalo Creek near junction with Buck Run. *Westmoreland County*: Congruity, 4 mi. E. of Delmont on Route 22; Derry; Longbridge; Hillside; near Laughlintown; 1 mi. E. of Kregar; along Conemaugh River, across from Saltsburg; Shades Ravine, 2 mi. E. of Trafford.

***Lycoperdon rimulatum* Peck**

Allegheny County: 1 mi. W. of Mount Nebo, L.K.H., 2966. *Fayette County*: Ohiopyle, O.E.J. *Venango County*: 1 mi. N.E. of Lisbon, L.K.H.,

840. *Westmoreland County*: Loyalhanna Creek, 2 mi. S. of Saltsburg, L.K.H., 4137.

***Lycoperdon subincarnatum* Peck**

Allegheny County: Sandy Creek, D.R.S.; Coraopolis, O.E.J. *Butler County*: Nixon Station on Butler Short Line, Wm. Millward. *Forest County*: 1 mi. N. of Brookstown, L.K.H., 3824. *Indiana County*: near Glen Campbell, L.K.H., 2127. *Westmoreland County*: Linn Run, 3 mi. S.E. of Rector, O.E.J.

***Lycoperdon umbrinum* Pers.**

Allegheny County: Black's Run, N. of Oakmont, O.E.J. *Bedford County*: 7 mi. N.E. of Everett, Morrison Cove region, L.K.H., 206. *Butler County*: Little Buffalo Creek, near Monroe Station, L.K.H., 1555; 4 mi. N.E. of Harmony, L.K.H., 2174; near Saxonburg, D.R.S. *Clarion County*: Cook Forest, O.E.J. *Indiana County*: Crooked Creek, 2 mi. above Chambersville, O.E.J. *Mercer County*: 2 mi. N.E. of Grove City, O.E.J. *Westmoreland County*: 1 mi. W. of Laughlintown, O.E.J.; near Rector, O.E.J.; Jones Mills, D.R.S.

***Crucibulum vulgare* Tul. (Plate III, fig. 5)**

Allegheny County: Forest Hills, Pittsburgh; Schenley Park, Pittsburgh; Wilkinsburg; Power's Run, opposite Verona; 4 mi. E. of Monongahela; $\frac{1}{2}$ mi. S. of Smithdale; 1 mi. N.E. of Ben Avon Heights; Frick Park, Pittsburgh; Glenshaw; 1 mi. N.E. of Sewickley; Imperial woods at intersection of Routes 22 and 30; Carnegie; along Route 910, 3 mi. S.E. of Bakerstown. *Armstrong County*: Kittanning. *Beaver County*: along Route 151, $3\frac{1}{2}$ mi. from junction with Route 18; Raccoon Creek State Park. *Bedford County*: Sulphur Springs. *Butler County*: Little Connoquenessing Creek, 3 mi. N.E. of Harmony; Slippery Rock; along Route 528, $\frac{1}{4}$ mi. S.E. of junction with Route 8; Nixon Station on Butler Short Line; near Butler; along tributary of Crab Run, 4 mi. N.E. of Harmony. *Cambria County*: near Cresson. *Centre County*: near Woodward. *Clearfield County*: Little Medix Run, 1 mi. N. of Caledonia Pike. *Elk County*: Route 55, 2 mi. E. of Medix Run. *Erie County*: Presque Isle; near Erie; 4 mi. S. of Girard. *Fayette County*: Ohiopyle; Killarney Park, S. of Normalville. *Lawrenceville County*: Rock Point; E. of Volant, along Route 278. *Somerset County*: Haines, W. of Jennerstown; 2 mi. W. of Berlin; Kooser State Park, on Route 31. *Washington County*: Distillery Stop, near New Eagle. *Westmoreland County*: Kiski Campus near Saltsburg; Linn Run, 3 mi.

S.E. of Rector; $2\frac{1}{2}$ mi. N. of Bolivar; Idlewild Park near Ligonier; Latrobe; Derry; Jones Mills; along Loyalhanna Creek, 2 mi. S. of Saltsburg; Shades Ravine, 2 mi. E. of Trafford; Waterford.

Nidularia pulvinata (Schw.) Fr.

Armstrong County: Kittanning, D.R.S. *Cambria County*: $1\frac{1}{2}$ mi. E. of Patton, R. Little.

Cyathus stercoreus (Schw.) DeToni (Plate IV, fig. 1)

Allegheny County: Highland Park, Pittsburgh; Edgewood Park, Pittsburgh; Frick Park, Pittsburgh; Glenshaw; Schenley Park, Pittsburgh; Brighton Road, N.S. Pittsburgh; Wilkinsburg; Rosedale; Avalon. *Armstrong County*: Kittanning, D.R.S. *Butler County*: 4 mi. N.E. of Harmony, L.K.H., 4474. *Erie County*: W. of Erie, O.E.J. *Indiana County*: Homer City, D.R.S. *Somerset County*: Laurel Hill Mountain, near Trent, C. M. Hepner. *Westmoreland County*: Shades Ravine, 2 mi. E. of Trafford, H.S.W.; Congruity, 4 mi. E. of Delmont on Route 22, L.K.H., 4750.

Cyathus striatus Willd.

Allegheny County: Thorn Hill, N. of Warrendale; Frick Park, Pittsburgh; 4 mi. E. of Monongahela; Schenley Park, Pittsburgh; Tom's Run ravine, above Dixmont; Warden Mine region, opposite Sutersville; near Warrendale; Power's Run, opposite Verona; Middle Road near Glenshaw; near Verona; 2 mi. N.E. of Emsworth, along Route 856. *Armstrong County*: Kittanning. *Beaver County*: Raccoon Creek, near Patton Point; Temple Hollow, 1 mi. N.W. of Aliquippa; along Raccoon Creek, S. tip of County. *Bedford County*: Morrison Cove region, 7 mi. N.E. of Everett. *Butler County*: Stone House on Route 8, 2 mi. N. of Muddy Creek crossing; Slippery Rock. *Cambria County*: near Cresson. *Centre County*: near Woodward. *Fayette County*: Ohiopyle. *Lawrence County*: Rock Point. *Somerset County*: Laurel Hill Mountain, near Trent. *Venango County*: 1 mi. N.E. of Lisbon. *Washington County*: Raccoon Creek at Potato Garden Run. *Westmoreland County*: Kiski Campus near Saltsburg; Latrobe; Linn Run, 3 mi. S.E. of Rector; Shades Ravine, 2 mi. E. of Trafford.

Scleroderma lycoperdoides

Allegheny County: Frick Park, Pittsburgh, D.R.S.; 1 mi. N.E. of Ben Avon Heights, L.K.H., 5403; North Park, L.K.H., 4686; Flaugherty Run at crossing of Route 51, $1\frac{1}{2}$ mi. N.W. of Carnot, L.K.H., 4896; Schenley Park, Pittsburgh, D.R.S.; Warden Mine region, opposite Sutersville,

H. Roslund. *Armstrong County*: Kittanning, D.R.S. *Beaver County*: Intersection of Beaver and Ambridge Roads, L.K.H., 4635. *Butler County*: 4 mi. N.E. of Harmony, L.K.H., 5503; 1 mi. S.E. of Whitestown, L.K.H., 4316. *Centre County*: Penn State College Campus; L.K.H., 5336; Woodward, D.R.S. *Fayette County*: Ohiopyle, O.E.J. *Washington County*: Distillery Stop near New Eagle; L.K.H., 5177; Raccoon Creek, 2 mi. above Murdocksville, L.K.H., 5371. *Westmoreland County*: Waterford, D.R.S.; Rock Run, 3 mi. S.E. of Rector, O.E.J.

***Scleroderma bovista* Fr. *sensu* Hollos**

Bedford County: Sulphur Springs, D.R.S. *Erie County*: Weiss Library Woods, 8 mi. S.W. of Erie, O.E.J.; Presque Isle, O.E.J. *Mercer County*: near West Middlesex, C. M. Hepner. *Westmoreland County*: near Saltsburg, D.R.S.

***Scleroderma aurantium* (Vaill) Pers. (Plate IV, fig. 2)**

Allegheny County: Frick Park, Pittsburgh; near Sandy Creek; Darlington Hollow, near Aspinwall; 1 mi. N.E. of Ben Avon Heights; near Wildwood; near Imperial; North Park; Glenshaw; Powers Run opposite Verona; 1 mi. W. of Mt. Nebo; Bellevue; Verona, near Sewickley; Black's Run, N. of Oakmont; Big Sewickley Creek, 2 mi. E. of Ambridge; 1½ mi. N.E. of Allison Park; along Montour Run, 2 mi. W. of Gibsonia. *Armstrong County*: Kittanning, D.R.S. *Beaver County*: Raccoon Creek, 2½ mi. S.E. of New Sheffield; Intersection of Beaver and Ambridge Roads; near Beaver. *Bedford County*: Sulphur Springs; near Everett; near Reels Corners. *Blair County*: Yellow Springs, off Route 22 beyond Altoona, D.R.S. *Butler County*: 4 mi. N.E. of Harmony; Little Buffalo Creek near Monroe Station; Nixon Stop on Butler Short Line; Watson's Run, 2 mi. S. of Leasuresville; Slippery Rock; Buffalo Creek, 3 mi. N. of Freeport. *Cambria County*: Gallitzin; Cresson; near Belsano. *Cameron County*: along Route 872, 10 mi. N.E. of Sinnamahoning, L.K.H. *Centre County*: Woodward; Headwaters of Black Moshannon Lake; State Game Lands No. 33, 3 mi. S.E. of Philipsburg; Penn State College Campus. *Clarion County*: Cook Forest; near Clarion; Redbank; near Leeper; 4 mi. N.E. of Parkers Landing. *Clearfield County*: State Game Lands No. 34, S. of Medix Run; along Dent's Branch of Little Medix Run. *Clinton County*: along Route 220 at Lamar, L.K.H. *Crawford County*: Conneaut Lake, J. A. Shafer. *Elk County*: Ridgeway, O.E.J. *Erie County*: Wintergreen Gulch, 3 mi. S.E. of Erie; Presque Isle; Weiss Library Woods, 8 mi. S.W. of Erie. *Fayette County*: Ohiopyle; Killarney Park, S. of Normalville; near Normalville.

Forest County: 1 mi. N.W. of Brookston; western part of Allegheny National Forest. *Indiana County*: Crooked Creek, 2 mi. above Chambersville; near Glen Campbell. *Lawrence County*: Muddy Creek falls at mouth of Muddy Creek, L.K.H. *McKean County*: Mt. Jewett; Tionesta Tract near Brookston; near Kane. *Mercer County*: 2 mi. S.W. of Mercer; Houston Junction near Mercer. *Potter County*: 7 mi. N.E. of Austin, along Route 872; near Odin. *Somerset County*: Kooser State Park, D.R.S.; Laurel Hill Mountains, near Trent; Haines, W. of Jennerstown; $\frac{1}{2}$ mi. N.E. of Pleasant Union. *Venango County*: 1 mi. N. of Lisbon; 3 mi. N.E. of Emlenton; Little Scrubgrass Creek, N.E. of Sutton's Mills. *Warren County*: Tionesta Tract near Brookston, L.K.H. *Washington County*: near Finleyville, O.E.J. *Westmoreland County*: Linn Run, Forbes Forest, 3 mi. S.E. of Rector; Kiski Campus near Saltsburg; South Greensburg; Shades Ravine, 2 mi. E. of Trafford; Seward; Jones Mills; Loyalhanna Creek, 2 mi. S. of Saltsburg; Derry; Hillside; Laurel Hill, along Route 271, 4 mi. E. of Waterford; Laurel Ridge near Kregar; Mellon Estate, 6 mi. S.E. of New Florence; 2 mi. above Kingston, Loyalhanna Gorge.

***Astraeus hygrometricus* (Pers.) Morgan (Plate IV, fig. 3)**

Allegheny County: near Sewickley; Wildwood; Sandy Creek; 4 mi. E. of Monongahala. *Butler County*: 4 mi. N.E. of Harmony; Plains Church, S.E. of Evans City. *Clarion County*: Cook Forest, O.E.J. *Erie County*: Presque Isle; Wintergreen Gulch, 3 mi. S.E. of Erie. *Fayette County*: Ohiopyle, O.E.J. *Somerset County*: 3 mi. W. of Bakersville, C. M. Hepner. *Westmoreland County*: Hillside; $\frac{1}{2}$ mi. N.E. of Trafford; Mellon Estate, 6 mi. S.E. of New Florence.

***Sphaerobolus stellatus* Tode**

Allegheny County: Frick Park; Pittsburgh, D.R.S.; Warden Mine region, opposite Sutersville, H. Roslund. *Armstrong County*: Kittanning, D.R.S. *Butler County*: near Slippery Rock, D.R.S. *Cambridge County*: near Cresson, D.R.S. *Westmoreland County*: Latrobe, D.R.S.

***Calostoma cinnabarina* Desv. (Plate IV, fig. 4)**

Centre County: S.E. part of State Game Lands No. 33, Rush Township, L.K.H., 5053. *Clearfield County*: State Game Lands No. 34, S. of Medix Run, L.K.H., 4951. *Fayette County*: Ohiopyle, O.E.J.; Wypm's Gap, near Humberston, R. Little. *Potter County*: Carter Camp, Mrs. Paul Wible. *Somerset County*: near Jennerstown, D.R.S.; near Somerset, L. Roenpage. *Westmoreland County*: Mellon Estate, 6 mi. S.E. of New Florence, O.E.J.;

Laurel Hill Mountain, 1 mi. from Laurel Summit, O.E.J.; Derry, D.R.S.; Forbes Forest, 3 mi. S.E. of Rector, O.E.J.

***Calostoma lutescens* (Schw.) Burnap**

Allegheny County: Coraopolis, D.R.S. *Armstrong County*: Templeton, D.R.S. *Fayette County*: Ohiopyle, H.S.W.

***Calostoma Ravenelii* (Berk.) Mass.**

Fayette County: Ohiopyle, M.B.K. *Westmoreland County*: Hillside, O.E.J.

SUMMARY

A key to the forty-four species of Gasteromycetes has been provided. Our collection of *Colus Schellenbergiae* is the only record of this species in the northern hemisphere.

Bovista minor, *Calvatia rubro-flava*, *Geaster velutinus*, *Lycoperdon coloratum* and *Lycoperdon eximium* are represented by one collection of each.

Lycoperdon pusillum, *Nidularia pulvinata*, and *Calostoma Ravenelii* were each collected in two different localities.

Bovistella radicata, *Calvatia maxima*, *Geaster mirabilis*, and *Calostoma lutescens* were obtained at three separate localities.

All species collected from more than three localities and yet not plentiful enough to be considered as common, have been designated by including the collector's name or initials after the locality.

Additional collecting in certain sections will be necessary in order to complete the knowledge of the distribution of the Gasteromycetes in our area.

BIBLIOGRAPHY

COKER, W. C. AND COUCH, J. N.

The Gasteromycetes of the Eastern United States and Canada. University of North Carolina Press. Chapel Hill, 1928.

JOHNSON, MINNIE MAY.

The Gasteromycetes of Ohio. Ohio Biological Survey, Bulletin 22, Vol. 17, No. 7.

LLOYD, C. G.

The Genera of Gasteromycetes. Bulletin of the Lloyd Library, Mycological Series, No. 1, 1-24, f. 1-49.

EXPLANATION OF PLATE I

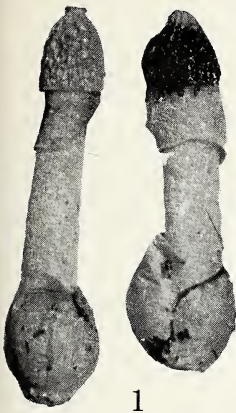
Anthurus borealis Burt. $\times 0.8$.

(Photograph, courtesy of D. R. Sumstine)



EXPLANATION OF PLATE II

- FIG. 1. *Dictyophora duplicata* (Bosc.) E. Fischer $\times 0.34$.
FIG. 2. Eggs or volvae of *Dictyophora duplicata*. $\times 0.4$.
FIG. 3. *Ithyphallus impudicus* (L.) Fries $\times 0.7$.
FIG. 4. *Mutinus Ravenelii* (B. & C.) E. Fischer $\times 0.9$.
FIG. 5. *Bovista pila* B. & C. $\times 0.6$.



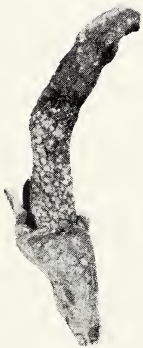
1



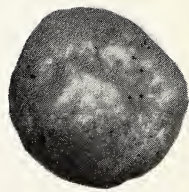
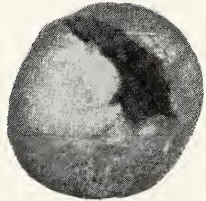
2



3



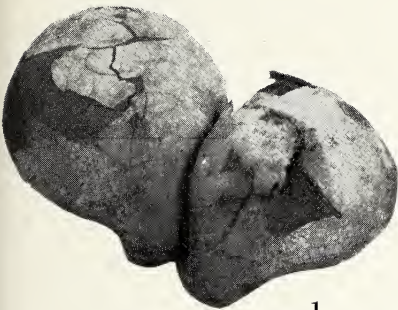
4



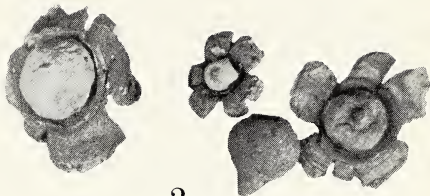
5

EXPLANATION OF PLATE III

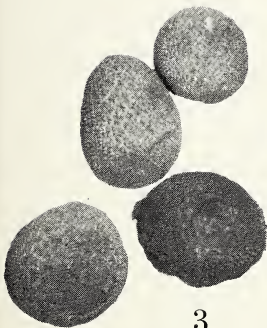
- FIG. 1. *Calvatia cyathiformis* (Bosc.) Morgan $\times 0.38$.
FIG. 2. *Geaster triplex* Jungh. $\times 0.6$.
FIG. 3. *Lycoperdon marginatum* Vitt. $\times 0.6$.
FIG. 4. *Lycoperdon gemmatum* Batsch. $\times 0.5$.
FIG. 5. *Crucibulum vulgare* Tul. $\times 0.75$.



1



2



3



4



5

EXPLANATION OF PLATE IV

- FIG. 1. *Cyathus stercoreus* (Schw.) De Toni $\times 1$.
FIG. 2. *Scleroderma aurantium* (Vaill.) Pers. $\times 0.7$.
FIG. 3. *Astraeus hygrometricus* (Pers.) Morgan $\times 1$.
FIG. 4. *Calostoma cinnabarina* Desv. $\times 0.8$.



1



2



3



4

0 1.13
P4 P6842



ART. XXI. NOTES ON SOME HYLID TADPOLES IN
LOUISIANA

BY GRACE L. ORTON

(PLATES I-II)

This paper is the second report on the herpetological collection made by the author in the vicinity of Baton Rouge, Louisiana, during the period of May 30 to June 20, 1945. The first paper, which appeared in these *Annals* (Orton, 1946) concerned some aspects of the larval development of *Microhyla carolinensis* (Holbrook).

The enjoyment and the success of this collecting trip were in large measure due to the generosity and hospitality of the staff of the Department of Zoology of Louisiana State University. I am particularly indebted to Prof. William H. Gates, Prof. Ellinor H. Behre, and Dr. Ira D. George.

Herpetological literature contains occasional references to the variability of tadpoles, but few studies have actually been made either on larval variation or on the more fundamental phenomenon that may be termed larval constancy. The information that is available along these lines is difficult to evaluate because of its meager amount and its limited scope. The present paper is an attempt to summarize the characteristics of some population samples of tadpoles of four hylids collected at Baton Rouge and nearby localities. It is hoped not only that the notes will contribute to a more precise knowledge of the diagnostic larval characters of the respective species, but that they may aid also in future comparative studies of geographic and ecological variation in these and related forms.

MATERIAL

The forms discussed in this paper are:

- | | |
|---|---|
| <i>Hyla cinerea cinerea</i> (Schneider) | <i>Acris crepitans</i> Baird |
| <i>Hyla squirella</i> Latreille | <i>Acris gryllus gryllus</i> (Le Conte) |

The tadpoles upon which the study is based are as follows:

Hyla cinerea cinerea

- Baton Rouge, East Baton Rouge Parish
- CM 24156 (3) Collected May 30
- 24161 (13) " May 31
- 24177 (28) " June 2
- 24227, developmental series from eggs laid night of June 6-7
- 24254 (2) Collected June 11
- 1 mile northeast of St. Francisville, West Feliciana Parish
- CM 24272 (25) Collected June 12



Hyla squirella

Baton Rouge, East Baton Rouge Parish

CM 24296, developmental series from eggs collected June 14

24312 (26) Collected June 16

Acris crepitans

Baton Rouge, East Baton Rouge Parish

CM 24155 (48) Collected May 30

24160 (24) " May 31

24200 (4) " June 4

24244 (2) " June 9

24256 (29) " June 11

24310 (3) " June 16

1 mile northeast of St. Francisville, West Feliciana Parish

CM 24271 (9) Collected June 12

Acris gryllus gryllus

2 miles east of Covington, St. Tammany Parish

CM 24335 (26) Collected June 18

I. *HYLA CINEREA CINEREA* (SCHNEIDER) AND
HYLA SQUIRELLA LATREILLE

The collection includes series of early developmental stages of two common coastal plain tree frogs, *Hyla cinerea cinerea* (Schneider) and *Hyla squirella* Latreille, and a considerable number of older tadpoles of the former species.

The tadpoles of *Hyla cinerea* and *H. squirella* were described in detail by Wright (1929). His accounts were illustrated by figures of the mouth-parts and lateral-view photographs of the tadpoles. In his later work (1932) much of the same material was repeated, with some additional small photographs. Wright and Wright (1933, 1942) briefly listed a few larval characters for each of these species. There appear to be no detailed published descriptions of the early post-hatching stages of either species.

Hyla cinerea cinerea

Early larval development: The developmental series of *H. c. cinerea* (CM 24227) was reared from eggs laid in the laboratory by a pair of adults (CM 24225-26) collected on the night of June 6, at the small lake immediately east of the Louisiana State University campus. The frogs were collected separately, but clasping began when they were placed together in an

aquarium, and the eggs were deposited during the night. General information on this developmental series is summarized in Table I.

TABLE I.

Early Larval Development of *Hyla c. cinerea* (CM 24227)

Unit	Time of preservation	Approximate number of hours since hatching	Remarks
a	June 7, 9:30 A.M.		Eggs, pre-gastrula.
b	June 7, 6:30 P.M.		Eggs; some with yolk plug, some with neural folds forming.
c	June 8, 9:30 P.M.		Total length ± 4.5 mm. Beginning to hatch. Tail about as long as head-body, head structures rudimentary, external gills short. No color pattern.
d	June 9, 9:00 A.M.	11½	Total length ± 4.5 to 5 mm. External gills longer. Color pattern developing.
e	June 9, 12:00 P.M.	14½	Total length ± 4.7 to 5.3 mm., some retarded specimens as small as 3 mm. Tail longer than body.
f	June 9, 6:00 P.M.	20½	Total length ± 3.5 to 5.5 mm., the smallest ones much retarded in structure and pattern development. Larger specimens have first traces of opercular folds laterally, eyes better defined, body becoming broad and round.
g	June 10, 10:00 A.M.	36½	Well developed specimens ± 6 mm. in total length, eyes prominent and heavily pigmented, opercula joined to form continuous transverse fold across chest. Mouthparts forming. Pigmentation well developed.
h	June 10, 4:00 P.M.	42½	Total length ± 4.7 to 6.5 mm. Advanced specimens have mouthparts better developed, nostrils developed. More heavily pigmented.
i	June 11, 11:00 A.M.	61½	Total length ± 4.7 to 7 mm. The larger specimens are in various stages of operculum closure and spiracle formation.
j	June 13, 10:00 A.M.	108½	Total length 6 to 10.5 mm. Have begun feeding.
k	June 17, 11:00 A.M.	205½	Total length 12.5 mm.

(about 8½ days)

The recently hatched larvae of unit *c* of the series measure ± 4.5 mm. in total length. The tail is about as long as the body, head structures are rudimentary, and the external gills are very short, with poorly defined branches. The color of the preserved larvae is light yellowish brown with no indication of a darker pattern.

During the next 12-hour period, total length increased to a maximum of ± 5 mm., and the external gills became somewhat longer, with better developed branches. The most conspicuous advance was in the development of pigmentation. The side of the tail musculature of these specimens (unit *d*) is uniformly dark brown except for a light lower edge. On the sides of the body the melanophores form sharply defined dark dots. The head is light brownish with no definite pattern.

In the more advanced larvae included in unit *f*, preserved nine hours later, the total length is 5-5.5 mm., and the body is thicker and more tadpole-like. The mouth opening is somewhat widened laterally, but labial structures are not yet developed. The adhesive organs are situated at the ventrolateral corners of the rudimentary mouth and are pale yellowish brown, like the adjacent head tissues. The external gills are well developed, conspicuously branched, and there are rudimentary opercular folds laterally. Pigmentation is better developed, distinct melanophores are present on the head, and extend farther down on the sides of the body than in the preceding stages. There are no dorsolateral light stripes extending from the eye to the base of the tail such as occur in certain other hyliids in this stage of development.

Extensive morphological advances occurred during the next 16 hours, and in unit *g* (10 A.M., June 10) the more advanced specimens measure ± 6 mm. in total length. In general, the body is stout, tadpole-like, the opercula have joined to form a single transverse fold across the chest, the external gills are prominent, and the eyeballs are well developed and heavily pigmented. The larval mouthparts are forming and the edges of the beaks are faintly pigmented. The small, pale, adhesive organs are situated at the ventrolateral corners of the developing lips. The larvae in this stage are heavily pigmented: tail musculature blackish except for very narrow white lower edge, tail fins remain unpigmented; entire body heavily blackened except for a moderately wide median clear area on the belly; opercular folds and throat dark.

In unit *h*, preserved 6 hours later (about 43 hours after hatching had begun), maximum total length is about 6.5 mm. The nostrils are open; the mouthparts are better developed, and faint traces of tooth rows can

be seen. The adhesive organs remain pale. At this stage, the body and tail musculature were black in life, except for the whitish lower edge of the latter and the yellowish central part of the belly. Over this ground color some of the more advanced larvae had, in life, a thin transverse yellow line extending across the back from the upper ends of the opercular folds. This yellow line faded following preservation. There was no trace of dorso-lateral light stripes. The yellow stripes on the snout, so prominent in older larvae, had not yet developed.

The majority of the larvae preserved 19 hours later (unit *i*) are in various stages of gill absorption and spiracle formation, and have a total length of ± 7 mm. The most advanced specimens have the form and proportions of typical tadpoles. The spiracle, when completed, is sinistral in position; the tooth rows are 2/2; traces of the adhesive organs are still present. Typical specimens in this unit are very heavily pigmented. The throat and pectoral region are uniformly black except for a small sparsely pigmented area immediately behind the lips, and a narrow but conspicuous white band across the chest marking the line of fusion of the opercular folds with the abdominal wall. The belly is black except medially where the pigment is interrupted by an irregular longitudinal light stripe flanked by a pair of narrow light lines. In some specimens the general color of the tail is much lighter than in preceding stages, the previously uniform black color giving way to a pattern of highly contracted, widely separated melanophores.

The last two units of the developmental series (*j* and *k*) were preserved after the tadpoles had begun feeding. In unit *j* (316 tadpoles), preserved approximately $4\frac{1}{2}$ days after hatching, maximum total length had increased to 10.5 mm. The mouthparts are well developed; the third lower tooth row had been added, making the tooth row formula 2/3. In life, the black body had a narrow transverse yellow line posterior to the gill region, a conspicuous yellow stripe extended from eye through nostril to the tip of the snout, and the dorsal edge of the tail musculature bore a line of yellow spots of variable size and number. Since preservation, the yellow markings on the snout and back have disappeared; the light spots on the tail musculature are still present but have faded to white. At this stage, the tail fins contain some scattered melanophores. The tail musculature is quite dark in some specimens, in others the caudal melanophores are strongly contracted except at the base and tip of the tail, and the general color of the musculature is thus pale.

Unit *k*, the final one in the developmental series, comprises 68 tadpoles

preserved on June 17, approximately 8 days after hatching. The maximum total length is 12.5 mm., and in the largest specimen the eyes have assumed a fully lateral position. In life the body was black with a variable amount of yellow stippling dorsally. The smaller specimens had a narrow, well defined, yellow band across the posterior part of the back and tended to have a second, less well defined, band behind the eyes. These transverse bands were less evident in the larger tadpoles in this unit because of diffusion of yellow pigment into the intervening areas. The yellow stripes on the snout were very prominent, the throat and belly velvety black, and the eyes iridescent bronze. The tail was pale greenish yellow, contrasting sharply with the predominantly black body. In some specimens there were conspicuous yellow flecks along the dorsal edge of the tail musculature. The light markings have faded since preservation except for a faint trace of the facial stripes in a few specimens. These stripes are due primarily to the presence of a formalin-soluble yellow pigment and only secondarily to any absence of underlying dark pigment. Hence they disappear almost completely following preservation.

Variation in developmental rate: An interesting feature of this larval series of *Hyla c. cinerea* is the considerable variation in developmental rate which is evident at an early stage and increasingly conspicuous in later stages. Whether great variability in developmental rate is a normal characteristic of the species cannot be decided on the basis of the single series studied.

Since the egg-laying process was not observed, the length of time it required is not known. If it were quite prolonged, it is possible that developmental differences noted in the earliest stages preserved (units *a* to *c*) were the result of differences in the exact time when individual eggs were fertilized. This possibility is not, however, sufficient to account for the striking differences noted in later stages. Up to the time active feeding began, the gap between least and most advanced specimens—so far as can be judged from the larvae preserved—is progressively greater in the older stages. The developmental differences are perhaps the most striking in unit *i*. Total lengths of larvae in this unit range from about 4.7 to 7 mm. Most are closer to the larger size and are well developed tadpoles in various stages of gill absorption and spiracle formation. The two most retarded specimens preserved at this time are in about the same developmental condition as normal larvae in unit *e*, preserved 47 hours earlier; their head structures are rudimentary, opercular folds have not yet formed, and pigment development is in an early phase. The larvae in unit *e* were pre-

served approximately 15 hours after the time when hatching began. Unit *i* was preserved approximately 62 hours following hatching. Thus, it required some larvae ± 62 hours to attain a developmental status accomplished in ± 15 hours by other larvae.

The final units in the series, *j* and *k*, likewise show considerable variation in size. These specimens, however, had been feeding, and their size variation is due in part to crowding, insufficient food, and related factors. Variation in developmental rate is, in these stages, less certainly responsible.

Older tadpoles: The series of older larvae of *Hyla cinerea cinerea* obtained in Louisiana do not contain sufficient specimens in all size groups to permit a detailed account of growth.

The largest *cinerea* tadpole listed by Wright (Okefinokee) measured 40 mm. in total length and 15 mm. in head-body length. The largest specimen in the Louisiana collection measures 49+ mm. in total length (tail tip regenerating), 19 mm. in head-body length, and has hind legs 14 mm. long. Although this single large specimen is not sufficient to indicate a larval size difference between Baton Rouge and Okefinokee populations, the future discovery of such a geographic difference would not be surprising in view of the larger size attained by Gulf Coast adults of *cinerea*.

Hyla squirella

Early larval development: The developmental series of *Hyla squirella* (CM 24296) comprises six units reared from eggs collected in the field. Adults of *squirella* were obtained on the night of June 13, when they emerged in response to a heavy rain, but the eggs laid in the laboratory during the night proved infertile. The same pool was re-visited the following afternoon, June 14, and a sufficient number of eggs were collected to provide a developmental series. The eggs were small, pale brown and whitish in color, and were scattered singly or in pairs on debris in water about 3 to 6 inches deep. In the early part of the afternoon the eggs were in the yolk plug stage. A summary of the data on this series is given in Table II.

The first specimens preserved (unit *a*) had just hatched. The four larvae in this unit are pale yellowish tan, the two larger specimens having a small amount of dark pigment along the dorsal edge of the tail musculature, on the upper sides, and along the head above and behind the eyes. There are few melanophores over the brain region.

TABLE II.

Early Larval Development of *Hyla squirella* (CM 24296)

Unit	Time of preservation	Approximate number of hours since hatching	Remarks
<i>a</i>	June 15, 8:00 P.M.		Total length ± 3.2 to 4 mm. Recently hatched. Smaller larvae with tail slightly shorter than body, gills very rudimentary, no color pattern. Larger larvae with longer tail, well developed gills, color pattern developing.
<i>b</i>	June 16, 11:00 A.M.	15	Total length ± 4.6 mm. Eyes becoming distinct. Opercular folds distinct. Mouthparts not yet formed.
<i>c</i>	June 16, 7:00 P.M.	23	Total length ± 4.8 to 5.5 mm. Eyes prominent, black. Skin transparent. Continuous opercular fold across chest. Mouthparts forming. Body broad and rounded.
<i>d</i>	June 17, 10:30 A.M.	38½	Total length ± 5.5 to 6 mm. Spiracle formed. Mouthparts well developed. Trace of adhesive organs still present. Larvae have begun feeding.
<i>e</i>	June 19, 1:00 P.M.	89	Total length 8 to 9.5 mm.
<i>f</i>	June 20, 10:00 A.M.	110	Total length 7.5 to 11.5 mm.

Two larvae comprise unit *b*. The external gills are moderately large and well-branched; the opercular folds are well developed and appear to be continuous across the throat. The mouth opening is somewhat widened, but labial structures are not yet apparent. The adhesive organs are pale. The melanophore pattern is somewhat better defined than in the preceding stage: upper edge of tail musculature pigmented, some pigment on upper part of head and sides, a fairly well defined dorsolateral light stripe from eye to base of tail.

The specimens in unit *c*, preserved 8 hours later, show considerable morphological advancement. The total lengths range from 4.8 to 5.5 mm. The body is broad and deep and the eyes are prominent and heavily pigmented. The lips are developing and the margins of the beaks are slightly pigmented; the adhesive organs are pigmented at the base only, and are situated at the ventrolateral corners of the lips. The opercula form a prominent transverse fold across the chest, the external gills are somewhat reduced. Internal organs are quite clearly visible through the rather

transparent skin. These larvae are more heavily pigmented than those in unit *b*, but the basic pattern remains essentially the same. The dorsum is dark except for a general weakening of pigmentation over the brain region; the dorsolateral light stripes are not as sharply defined as in certain other hylids (notably *H. crucifer*), for in *squirella* the stripes consist of a series of more or less confluent unpigmented spots. Dark pigment on the side of the head is interrupted by a prominent light area below the eye. The upper part of the sides, and the upper third or less of the tail musculature, are quite heavily pigmented; the caudal blood vessel dorsal to the notochord is black distally, making a thin straight dark line visible through the translucent tail musculature. The skin over the lower sides, belly, and throat is free of dark pigment.

At this point, observations on CM 24312 may be interpolated. These larvae were collected in the same small pool as the eggs that provided the developmental series, and are morphologically intermediate between units *c* and *d* of that series. There are 26 specimens, ranging from 4 to 5.6 mm. in total length. Most of the specimens are in various stages of operculum formation or gill absorption. In the largest one, the spiracle has formed. The typical color pattern characters are: upper edge of tail musculature dark, the pigment only slightly encroaching on sides of musculature; dorsolateral light stripes from eye to base of tail indicated but usually not very sharply defined; dark pigment along sides of head more or less widely interrupted below eye; throat and belly unpigmented, sides largely so.

Discussion of the developmental series, CM 24296, is resumed with unit *d*. The larvae at this time were well developed and had begun active feeding. The total lengths of these specimens are approximately 5.5 to 6.2 mm. The spiracle and mouthparts are formed in all. The tooth row formula is $2/2$; a third lower tooth ridge appears to be present, but its teeth are not visible at the magnification used. Small brown remnants of the adhesive organs are present at the ventrolateral corners of the lips. The eyes are widely separated but not fully lateral; the nostrils are small, inconspicuous, and widely separated. The color pattern remains essentially as in unit *c*, although there is a somewhat greater amount of dark pigment, and it extends somewhat farther down on the sides of the body and tail. The latter, however, is still sharply bicolor and pigmented on only the upper half or less. The throat and belly are still entirely unpigmented, the prominent light spot below the eye is still present, and the dorsolateral light stripes are variable in distinctness.

The tadpoles in unit *e*, preserved about 50 hours later, are 8 to 9.5 mm. in total length. The snout is moderately long, bluntly rounded; tooth formula $2/3$; no remaining trace of adhesive organs; spiracle sinistral; anus dextral. The color pattern is variable in some details. In life, the dorsum was black with scattered flecks of yellow pigment and a trace of dorsolateral light stripes. Examination of the preserved larvae shows that the tail musculature is somewhat more heavily pigmented than in earlier stages. Although it is still sharply bicolor, some pigment flecks have developed on the lower half. There is also a small amount of dark pigment in the fins. The dorsolateral light stripes are considerably broken up but are evident in three specimens, not clear in the other two (the largest and smallest larvae in this unit). In the four smallest larvae the unpigmented spot below the eye is still prominent; in the largest specimen dark pigment has invaded the area and largely obliterated the spot. There is a sharp line of demarkation between the dark side of the head and the unpigmented throat. Dark pigment extends farther down on the sides than in preceding units. In this stage, there is still no dermal pigment over the belly.

The final unit of the series, unit *f*, comprises 16 larvae, ranging from 7.5 to 11 mm. in total length. The body is deep and rounded, and the eyes are somewhat more widely separated than in earlier stages, the corneas being just lateral. The tooth formula is $2/3$, the third lower row quite long. In life the dorsolateral yellowish stripes were evident; the dorsum between the stripes had a greenish yellow cast over a black background; sides darker. There was a trace of yellow pigment on the belly, the throat was white, there was a row of prominent yellow flecks along the dorsal edge of the tail musculature and, in some specimens, a yellowish wash on the sides of the tail base. Some dark pigment was present in the fins. There were no yellow stripes on the snout or transverse yellow lines on the dorsum such as occur in *cinerea*. Since preservation, the yellow pigment has faded, leaving only the pattern of melanophores and unpigmented areas. In this developmental stage, there is still no dermal pigment over the belly, the dark color seen in most of the specimens being due chiefly to the color of the internal organs and intestinal contents. In some specimens there are a few scattered melanophores on the throat. The tail musculature remains distinctly bicolor, although at this stage considerable dark pigment has developed on the lower half of the tail. In all 16 larvae there is still some indication of the suborbital light spot on one or both sides, although it is much more restricted by encroaching dark pigment than in earlier stages.

COMPARISONS

So far as can be generalized from the single developmental series of each species, *Hyla c. cinerea* and *H. squirella* differ conspicuously in several aspects of early larval development, particularly in developmental rate, size, and color pattern.

TABLE III.

Larvae of *Hyla c. cinerea* and *H. squirella* in Three Early Developmental Stages
Total length and pigmentation (after preservation)

STAGE I

Recently hatched. Body laterally compressed. Eyes poorly developed. External gills forming, but no opercular folds. Mouthparts not yet developed- (Approx. stages 21-22 of Pollister and Moore for *Rana sylvatica*.)

Hyla c. cinerea, CM 24227

±5 mm. Tail muscle uniformly dark except for light lower edge. Melanophore pattern extends well down on sides of head and body. (Pl. I, fig. 1)

Hyla squirella, CM 24296

±4 mm. Tail muscle with dark pigment only along upper edge. Few melanophores on sides of head and body below level of eye. (Pl. I, fig. 4)

STAGE II

Opercula joined to form complete transverse fold across throat, but not yet fusing to delimit spiracle. External gills at maximum development. Eyes well developed. Mouthparts becoming differentiated (Approx. stage 23 of Pollister and Moore for *Rana sylvatica*.)

Hyla c. cinerea, CM 24227

±6 mm. Tail muscle still dark except for light lower edge. Body uniformly black except for narrow light mid-ventral area. Throat black. No dorsolateral light stripes. (Pl. I, fig. 2)

Hyla squirella, CM 24296

±5.5 mm. Tail muscle still white except for dark dorsal edge. Sides, throat, and belly white. Dark pigment on side of head interrupted by prominent light area below eye. Dorsolateral light stripes indicated but not sharply defined. (Pl. I, fig. 5)

STAGE III

Spiracle formed. Trace of adhesive organs still present. Mouthparts formed, larvae feeding.

Hyla c. cinerea, CM 24227

±7 mm. Tail pattern essentially as before but its general appearance paler due to contraction of melanophores. Ground color of head and body entirely black. (Pl. I, fig. 3)

Hyla squirella, CM 24296

±6 mm. Dark pigment on tail muscle confined to its upper half. Throat, lower sides and belly, and spot below eye still white. Dorsolateral light stripes still indicated. (Pl. I, fig. 6)

Although temperature is in general an important influence on the developmental rate of amphibian embryos, the temperature was too uniform during the period to account for the considerable difference in rate observed between these two species. The most rapidly developing individuals in the series of *cinerea* required a minimum of about 61 hours between time of hatching and completion of spiracle formation. In the series of *squirella*, spiracle formation took place between 23 and 38 hours after hatching (exact time uncertain because of gaps in the series).

The larvae of *squirella* are considerably smaller than those of *cinerea* in comparable developmental stages. Young larvae that show traces of pattern formation but still lack opercular folds have total lengths of 3.5 to 4 mm. in *squirella*, 4.5 to 5 mm. in *cinerea*. At the completion of spiracle formation, total length in the two series studied is 5.5 to 6 mm. in *squirella*, ± 7 mm. in *cinerea*.

In the early larval stages the most striking difference between the two species is in the color pattern. In both species the ground color of the young larvae is a light yellowish brown. Specific differences in pattern are evident from the first appearance of overlying dark pigment (Plate 1 and Table III). The young larvae of *cinerea* have the following diagnostic color and pattern characters in life: sides of tail musculature uniformly pigmented, not bicolor; after initial developmental stages, tail pale greenish yellow in strong contrast to the velvety black body; throat, chest, and (usually) belly uniformly black; no dorsolateral light stripes along body; 1 or 2 narrow transverse yellow lines across back, anterior one less distinct; a prominent curved yellow stripe on side of snout from eye through nostril to near tip of snout. The contrasting diagnostic color and pattern characters (in life) of young *squirella* larvae are: tail musculature sharply bicolor, but with some dark pigment gradually developing on the pale lower half in later stages; throat and belly white; a prominent light spot below eye; more or less distinct longitudinal dorsolateral light stripes on back; no transverse yellow lines on back, no yellow stripes on snout.

During early larval development, changes in structure and pigmentation are rapid and the limits of "stages" are necessarily rather arbitrary. For the two species of *Hyla* under consideration in this paper it has been found useful to define three early developmental stages, using some easily recognized morphological criteria. In these stages there are important interspecific differences in pigmentation. The three stages and their characters in *cinerea* and *squirella* are summarized in Table III. This summary is not intended to represent normal tables of development of the type

commonly prepared by embryologists (*vide* Pollister and Moore, 1937), for age and temperature correlations are not included, and the emphasis is on somewhat more advanced larvae than those usually considered in embryological studies.

II. *ACRIS CREPITANS* BAIRD AND *ACRIS GRYLLUS GRYLLUS*

(LE CONTE)

Viosca (1944) has stated that in southeastern Louisiana there are two distinct forms of *Acris* which are characterized by differences in appearance, in voice, and in ecology. My limited experience in the same area accords with his observations to the extent that there are two morphologically distinguishable forms with characteristic ecological preferences. I did not hear a sufficient number of calls of *gryllus* to be able to differentiate the two on the basis of voice, but I did find that in this area the tadpoles were readily separable. For the purposes of the present paper, it appears best to follow Stejneger and Barbour (1943) in regarding *crepitans* and *gryllus* as full species.

The first detailed description of the tadpole of *Acris gryllus* appears to be that of Wright (1929), and this description forms the basis for most subsequent accounts of tadpoles of this genus. O. P. Hay (1890) made a few comments on the mouthparts of larval *Acris crepitans*, but Walker (1946) appears to be the first to describe this tadpole in adequate detail.

Acris crepitans

The tadpoles of *Acris crepitans* in the present collection include specimens in all developmental conditions except the early stages prior to the beginning of active feeding. The range in total length is 8.5 to 45.5 mm.; the largest specimen has a snout-vent¹ length of 15.5 mm., and is near transformation. The other larvae in similar developmental condition (26 specimens) range from 32 to 39 mm. in total length, 11.5 to 14 mm. in snout-vent length.

Some indication of the developmental rate of the hind legs in *crepitans* can be obtained from these series. In the material studied, the leg buds become visible as minute rounded bumps when the tadpole attains a total length of about 13 mm. In smaller larvae (at least from 8.5 mm.) the

¹ The head-body measurement used in this paper is taken from the tip of the snout to the ventral base of the tail; the anal tube is composed of soft flexible tissue and in small tadpoles it does not provide an accurate basis for measurement. In specimens that are near transformation, the anus is in essentially the adult position and an accurate snout-vent measurement can be taken.

position of the future leg bud is marked by a small jet black spot. The leg buds begin to elongate distinctly at a total length of about 17 to 18 mm. From this size to approximately 26 mm., growth of the leg buds appears to be slow, the structures gradually attaining a readily measurable length of about 1 to 1.5 mm. While the tadpole is increasing in total length from about 26 or 27 to about 30 mm., the foot and joints become differentiated and the leg bud increases in length to about 2 or 3 mm. Accelerated growth of the hind legs begins at a total length of about 31 to 33 mm.; from this period, the hind legs rapidly attain transformation size.

The black tail tip, usually regarded as a diagnostic character of *Acris* tadpoles, is by no means of constant occurrence in these series of Louisiana *crepitans*. In compiling the data on occurrence of the black tip, specimens with damaged or apparently regenerating tail tips were not counted. In the material at hand, a well-defined jet black tail tip is not present in any specimens with a total length of less than 19 mm. Of the 74 larvae with complete tails and a total length of 19 mm. or over, only 18 larvae (24.3 per cent) have a well-defined jet black tail tip. Eight additional specimens in this size group, and two slightly smaller larvae, show some concentration of black spotting in the tail tip, but with no coalescence of pigment areas to form a solid dark tip. In the Ohio larvae reported upon by Walker (1946) the black tail tip was found to extend forward for nearly one-third the length of the tail in some specimens.

Summary of important characters of the Louisiana A. crepitans tadpoles: Maximum total length 45.5 mm. (snout-vent 15.5), but typically these larvae reach only 32 to 39 mm.

Body moderately broad and deep, head tends to be relatively narrower and eyes more dorsal than in typical *Hyla* tadpoles. Tail long, fins moderately high, tail tip pointed. Nostrils of moderate size, somewhat enlarged in some specimens that are full grown or nearly so. Spiracle sinistral, with distinct inner rim but no long freely projecting tube. Anus dextral, its structure simple. Tooth formula 2/2, second upper row divided medially, the rest continuous. Typically, the second upper and second lower tooth rows extend distinctly farther laterally than ends of first upper and first lower rows respectively. Lips not infolded laterally. Beaks with moderately wide black edges.

In the preserved material the important color pattern elements are as follows: a conspicuous dark stripe along side of snout below nostril, bordered below by an equally wide and conspicuous light stripe; a vertical dark band beginning at lower edge of otic capsule and extending down

across gill region, then narrowing to form a narrow black band across the chest; in large specimens, region below eye dappled with large rounded light areas; throat with little or no dark pigment; dark pigment on dorsal body musculature and dorsal edge of tail musculature usually forms prominent rectangular bars or spots; tail fins and sides of tail musculature finely mottled and reticulated with dark gray, except in the region of the dorsal dark spots; tail tip plain in all specimens below 19 mm. total length; a well-defined jet black tail tip present in 18 (24.3 per cent) of the 74 specimens above this size.

In life the dorsum was mottled brownish gray and yellowish gray; sides of body more or less distinctly marbled with light yellowish areas on dark; belly grayish white with pink iridescence; central part of throat somewhat darker than belly, sides of throat heavily dappled with light areas on dark; light stripe on side of snout light pinkish yellow; tail musculature pale dull yellow lightly mottled with gray and dotted with brighter yellow specks; spots on dorsal edge of musculature dark brownish gray; tail sometimes with a broad jet black tip contrasting sharply with colors of adjacent tissues; the smallest specimens (8.5 to 15 mm. total length) had a very distinct reddish wash over body and upper edge of tail musculature.

Acris gryllus gryllus

The single series of *Acris g. gryllus* tadpoles obtained comprises 26 specimens ranging from 18 to 38 mm. in total length, 7 to 13 mm. head-body length. Several of the largest ones are near transformation.

Only 3 of the 26 *gryllus* larvae (total lengths 18, 31.5, and 34 mm.) show any trace of a black tail tip other than a darkening of the distal part of the notochord, which shows through the translucent muscle tissue in most of the specimens. In none of these three is there a conspicuous amount of black in the tip. In the Okefinokee region, Wright (1932) reported the black tail tip is "at times lost." The measurements of the 26 specimens, with respect to total length and length of hind leg buds, are so similar to those of the much more extensive series of *crepitans* as to suggest that leg bud differentiation in correlation with tadpole size is essentially the same in the two species, at least in the populations sampled.

Wright (1929, 1932) emphasized the prominent tubular extension of the spiracle in tadpoles of *gryllus*. In CM 24335, the spiracular tube is greatly prolonged in the larger specimens, less so in the smaller ones, but in the series as a whole it is far better developed than in *crepitans*.

TABLE IV.

Principal Differences Between Tadpoles of *Acris crepitans* and *gryllus* in Southeastern Louisiana

Character	<i>crepitans</i>	<i>g. gryllus</i>
Spiracle tube	Very short, not projecting out from body as a free tube.	Long and conspicuous, projecting free from body wall.
Stripes on side of snout	Light and dark stripes of about equal width.	Light stripe very narrow and partly obliterated by encroaching dark pigment.
Throat and chest	Throat light; a dark stripe begins below otic capsule and extends vertically down side of gill region, then transversely across chest.	Entire throat dark, hence no separate dark band across chest.
Sides of tail	Finely mottled and reticulated with grayish.	Sharply flecked with dark in addition to some fine mottling.
Dorsal surface of axial musculature	On body: pale, with strongly contrasting dark saddle spots. On tail: usually with a linear series of rectangular dark spots, rarely a continuous dark stripe.	On body: typically dark, seldom a conspicuous pattern. On tail: dark pigment usually forms a continuous dark stripe except on the very thin distal part of tail.

So far as they are represented in this collection, the tadpoles of *crepitans* and *gryllus* are much alike in size and general proportions, and there appear to be no important differences in the mouthparts. They are, however, amply distinct. The chief differences, as listed in Table IV and indicated in Plate II, are in pigmentation and in size of the spiracle tube.

LITERATURE CITED

HAY, O. P.

1890. Notes on the life-history of *Chorophilus triseriatus*. Amer. Nat., 23: 770-774, pl. 35.

ORTON, GRACE L.

1946. Larval development of the eastern narrow-mouthed frog, *Microhyla carolinensis* (Holbrook) in Louisiana. Ann. Carnegie Mus., 30: 241-248, 1 pl., 1 fig.

POLLISTER, ARTHUR W., AND JOHN A. MOORE

1937. Tables for the normal development of *Rana sylvatica*. Anat. Rec., 68: 489-496, tables 1-5.

STEJNEGER, LEONHARD, AND THOMAS BARBOUR

1943. A check list of North American amphibians and reptiles (5th edition). Bull. Mus. Comp. Zool., 93: xix + 260 p.

VIOSCA, PERCY, JR.

1944. Distribution of certain cold-blooded animals in Louisiana in relationship to the geology and physiography of the state. Proc. La. Acad. Sci., 8: 47-62, figs. 1-3.

WALKER, CHARLES F.

1946. The amphibians of Ohio. Part I. The frogs and toads (Order Salientia). Ohio State Mus. Sci. Bull., 1 (3): 1-109, pls. 1-14, figs. 1-28.

WRIGHT, ANNA ALLEN, AND ALBERT HAZEN WRIGHT

1933. Handbook of frogs and toads. xii + 231 p., 81 pls. Ithaca: Comstock Publishing Company.
1942. Handbook of frogs and toads (2nd ed.). xi + 286 p., 88 pls. Ithaca: Comstock Publishing Company.

WRIGHT, ALBERT HAZEN

1929. Synopsis and description of North American tadpoles. Proc. U. S. Nat. Mus., 74: 1-70, pls. 1-9.
1932. Life-histories of the frogs of the Okefinokee Swamp, Georgia. xvi + 497 p., 45 pls. New York: The Macmillan Company.

EXPLANATION OF PLATE I

Three Early Larval Stages of *Hyla c. cinerea* and *Hyla squirella*.

Hyla c. cinerea. CM 24227.

FIG. 1. Total length, 5 mm.

FIG. 2. Total length, 6 mm.

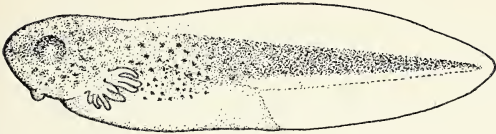
FIG. 3. Total length, 7 mm.

Hyla squirella. CM 24296.

FIG. 4. Total length, 4 mm.

FIG. 5. Total length, 5.5 mm.

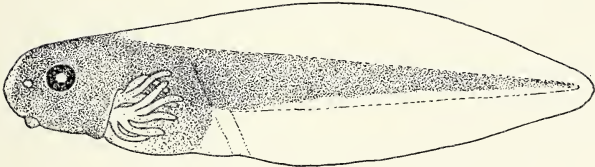
FIG. 6. Total length, 6 mm.



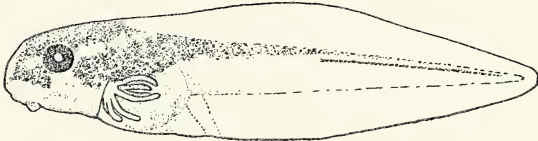
1



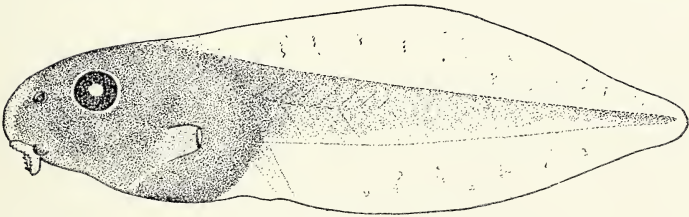
4



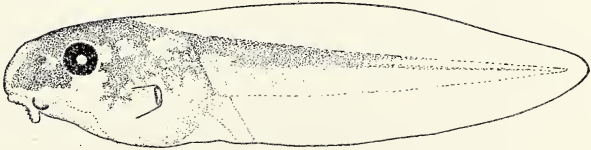
2



5



3



6

G.L.O.

EXPLANATION OF PLATE II

Tadpoles of *Acris*.

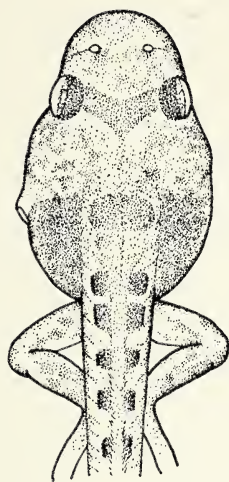
FIG. 1. *Acris crepitans*. Dorsal view. CM 24160. Total length 38 mm. Note short spiracle tube, and pattern of rectangular spots on dorsal edge of tail muscle.

FIG. 2. *Acris g. gryllus*. Dorsal view. CM 24335. Total length 34 mm. Note long spiracle tube, and dark stripe on dorsal edge of tail muscle.

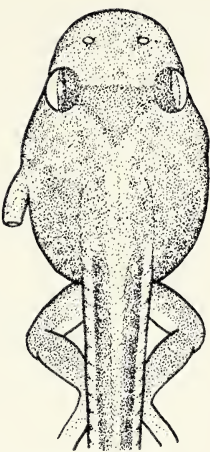
FIG. 3. *Acris crepitans*. Lateral view. CM 24160. Total length 33 mm.

FIG. 4. *Acris g. gryllus*. Lateral view. CM 24335. Total length 34 mm.

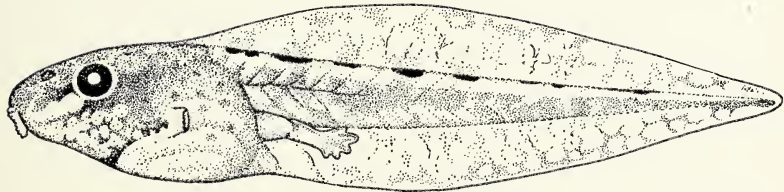
In specimens selected for figures 3 and 4, the tail lacked a distinct black tip.



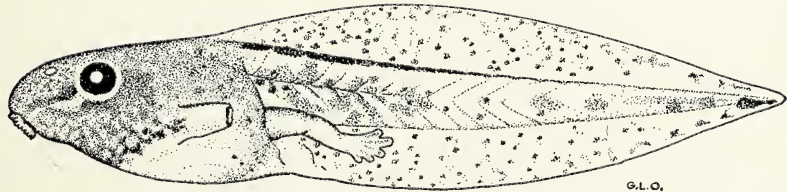
1



2



3



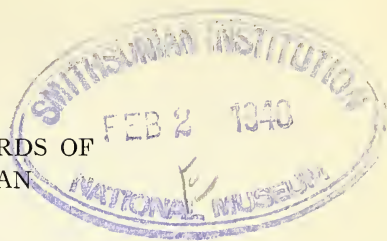
G.L.O.

4

007.73
PAP6842

ART. XXII. NOTES ON THE BIRDS OF
SOUTHERN SASKATCHEWAN

By W. E. CLYDE TODD



INTRODUCTION

In the fall of 1931 the writer, then on one of his several trips to James Bay, was accompanied by Mr. Albert C. Lloyd, who earlier in the year had been assisting Mr. John B. Semple and Dr. George M. Sutton on their expedition to Churchill, Manitoba. Mr. Lloyd's home was in southern Saskatchewan, and he naturally had much to say about the bird life of that section—so much, indeed, that a collecting expedition thereto loomed as a most desirable proposition. The authorities of the Carnegie Museum approved and agreed to sponsor the project, and accordingly Mr. Lloyd was sent ahead, and began work on April 21, 1932. Dr. Sutton came into the project under a special arrangement; he traveled with the writer from Chicago and we joined Mr. Lloyd at Davidson, Saskatchewan, on May 19. Mr. Lloyd had already accumulated a fine series of geese, cranes, and some other species, and the three of us continued to work together until June 30. Our combined efforts netted a total of 730 specimens of birds and 70 sets of birds' eggs. After our departure Mr. Lloyd continued to collect sporadically, and 94 additional specimens of birds and one of birds' eggs were acquired for the Carnegie Museum by purchase. The entire collection of 824 specimens is herewith listed by localities, with appropriate remarks under each species. In addition several species are included on the basis of sight records alone.

The plains of Saskatchewan are vast and wide, and are broken only by streams and sloughs, where waterfowl of many kinds breed in abundance. Trees (mainly poplars and willows) grow only along the watercourses, or where planted by human agency; a lone tree is a landmark for many miles. The avifauna is that of the prairies, but since by far the greater part of the land has been brought under cultivation this fauna is now much restricted and localized. The use of a car made these favored areas readily accessible, and enabled us to cover considerable territory. From Davidson as a center we explored the country north and west to a distance of 14 miles. On May 22 we moved our headquarters to a cottage on Last Mountain Lake, at a point east of Imperial. From this point we worked the west shore of the lake in both directions, and the islands in the center, at the north end.

The sloughs and prairie meadows at the head of the lake were a favorite collecting ground. There was a slough just east of Stalwart that proved to be an interesting spot. Two trips were made to Devil's Lake, six miles west of Amazon; here was a grove of small trees. On June 8 we drove to Elbow, on the Saskatchewan River, where we remained until June 11. Our work there was done on the plains on the west bank of the river, some three miles west of the town. This was the only place where we found the Long-billed Curlew. On June 20 we made an excursion to Quill Lake, near Dafoe, but remained only one day; we returned across the "Touchwood Hills" by way of Raymore. Two visits were made to Quinn's Lake, ten miles north and two miles east of Davidson—the last on June 28.

In the present paper, unless otherwise specified, the author is responsible for the identifications of and critical remarks on the various species. In general the American Ornithologists' Union Check-List has been followed (with its revisions to date), but in a few cases he has seen fit to differ. In discussing the seasonal status, nesting, haunts and habits, etc., of the several species he has utilized not only his own field notes made on the spot, but also those of Dr. Sutton, duly placed at his disposal, and certain written and verbal information kindly supplied by Mr. Lloyd. The list comprises 163 forms, a few of which are incompletely identified. A brief popular account of the expedition appeared in the Carnegie Magazine for September, 1932 (vol. 6, pp. 115-116), under the title "Glimpses of Prairie Bird Life."

Acknowledgments are due to the late Reuben Lloyd (father of Albert C. Lloyd) for his many courtesies to our party; without his whole-hearted cooperation the trip would not have been nearly so successful. We are also under obligations to the Provincial authorities of Saskatchewan for the issue of collecting permits, and to the Royal Canadian Mounted Police at Regina for permits to carry firearms.

LIST OF SPECIES

***Gavia immer elasson* Bishop. LESSER LOON.**

Single birds were seen on Last Mountain Lake on May 24, 26, and 27, and two on June 18. One was seen at Quill Lake on June 20. The June dates would suggest breeding.

***Colymbus grisegena holbölli* (Reinhardt). HOLBOELL'S GREBE.**

Two specimens: Last Mountain Lake.

Several pairs were nesting in a shallow, sheltered bay on the west shore

of Last Mountain Lake. They were first noted there on May 26, and two females collected on June 3 were getting ready to lay. On June 15 a set of six eggs was collected, and on June 22 two more, of five and four eggs respectively. The nests were merely masses of green vegetation floating a few inches above the surface of the water, but anchored to the bottom by growing aquatic plants. They were thirty to forty feet from shore, in shallow water, and were easily reached by wading out. The set of five eggs varied from fresh to one third incubated. All were much discolored by the water and muddy vegetation.

***Colymbus auritus* (Linnaeus). HORNED GREBE.**

Two specimens (downy young): Davidson, July 20.

A common breeding bird in the sloughs and marshes; pairs were found even in small areas of marsh. The first nest was found at Davidson on May 20, on which date it had only one egg. Full sets were found at Last Mountain Lake on May 28, at Davidson on June 7, and in a slough west of Raymore on June 21. This last nest was built about a submerged fence-post base; both birds were quite tame. Even as late as June 26 a nest with four eggs was found near Davidson.

***Colymbus nigricollis californicus* (Heermann). EARED GREBE.**

Eleven specimens: Last Mountain Lake and Davidson (13 miles west).

A summer resident, if anything more common than the Horned Grebe. It was noted at all the localities visited, and was particularly numerous at Last Mountain Lake. No eggs were collected, however, until June 16, when Dr. Sutton secured a set of three in the marsh near Stalwart. Again on June 29 he took five sets of three each, well advanced in incubation, from a slough by the roadside, about thirteen miles west of Davidson. In every case the nest was merely a floating mass of dead grasses and debris in the midst of a grassy part of the prairie slough, where the water was about two feet deep.

***Aechmophorus occidentalis* (Lawrence). WESTERN GREBE.**

Six specimens: Last Mountain Lake.

This species was noted only on the larger bodies of water—Last Mountain Lake and Quill Lake. At the former lake Mr. Lloyd counted as many as sixty-four birds on May 23; these were of course migrants. On May 28 and June 1 courtship antics were noted; at such times the birds sometimes pick up bits of grass and hold these in their bills. Four specimens were collected on June 3, after chasing the birds around and forcing them to

dive, then shooting quickly when they emerged. Often they escaped by quick diving, but it never seemed to occur to them that they could easily evade pursuit by flight. Of the four species of Grebes found here, the Western was by far the wariest and most difficult to collect. Those taken on June 3 showed no evidence of breeding as yet, but on June 18 three nests, probably of this species, were found ready for eggs. Many were noted at Quill Lake on June 20.

***Pelecanus erythrorhynchos* Gmelin. WHITE PELICAN.**

This species is not known to breed at Last Mountain Lake, where, however, it was seen repeatedly at various dates from May 23 to June 18. Usually only two or three would be seen at a time, but on several occasions large flocks passed over—a wonderful sight. The species is reported as breeding at Quill Lake, where many were seen on June 20.

***Phalacrocorax auritus auritus* (Lesson). DOUBLE-CRESTED CORMORANT.**

There was a Cormorant colony, estimated to number at least one hundred pairs, on a rocky island on the west shore of Last Mountain Lake. Our first visit was paid to this colony on May 28, at which time most of the nests had eggs—two with seven each, several with five or six, and many with four and three. Two nests had eggs already pipped, and one had newly hatched young. Our second visit was on June 23. All the birds took wing when we came within a hundred yards, and left the young to our mercies. For a while they kept circling overhead, but they finally settled on the water at a little distance. The stench at the nests from decaying fish, covered with swarms of flies, was beyond words. The nests on the highest and central part of the island all had large young, which stood up clamoring for food and paying no attention to us, while their heads and throats kept quivering in peculiar fashion. They would work themselves up to a point where they would disgorge partly digested fish, after which they would remain quiet for a time, and then repeat the performance. From these large young in the center there was a regular gradation in size to those on the periphery of the colony, each zone of nests holding successively smaller young, until in the outermost there were unhatched eggs. It was as if the first birds to begin nesting here took the highest part of the island, and later comers had to be content with lower positions. The newly hatched young were naked, helpless creatures, lying sprawled on their sides as if dead. It was a hot day, and we left soon so that their parents could shelter them.

In addition to this large colony, we found several nests on May 23 on the west side of the lake, on a point where Ring-billed Gulls were also breeding. Mr. Lloyd tells me that at one time the breeding cormorants on Last Mountain Lake were confined to the island. Then the water level of the lake was raised and the island was flooded; this forced the colony to move to the mainland. As the water receded in later years, however, the bulk of the colony again removed to the island, leaving only a few odd pairs behind. Why the colony was not wiped out by coyotes during the period remains a mystery.

***Ardea herodias herodias* Linnaeus. GREAT BLUE HERON.**

On June 18 a pair of this species was noted and their nest was located on an island on Last Mountain Lake north of our headquarters. The nest was built in one of the larger trees on this island, and held three eggs. It was not far from several crows' nests.

***Nycticorax nycticorax hoactli* (Gmelin). BLACK-CROWNED NIGHT HERON.**

Two specimens: Last Mountain Lake.

A summer-resident species, but not common. Dr. Sutton saw about twenty on May 29, but after the first of June only single odd birds or a pair were seen at one time. I used to flush a pair every time I crossed a certain slough near Last Mountain Lake—always at the same spot. It never occurred to me to look for a nest there, supposing as I did that this species always nested in trees, but I am now satisfied that this pair must have had a nest in the heavy growth of cattails at this point. This suspicion was later inferentially confirmed by Dr. Sutton's finding of a nest with three half-grown young in a slough near Quinn's Lake on June 23, in a situation entirely similar.

***Botaurus lentiginosus* (Montagu). AMERICAN BITTERN.**

With but a single specimen from the Pacific coast available for comparison, I am unable to recognize the characters upon which Brodtkorb (Occ. Papers Univ. Michigan Mus. Zool. No. 333, 1936, 2) relies for the discrimination of a western race of this species, but in any case the Saskatchewan bird is the same as the eastern one. We have a few sight records for Last Mountain Lake, May 28–June 14, and one for the slough near Stalwart, June 16. Three were seen at Quinn's Lake on June 28.

Cygnus columbianus (Ord). WHISTLING SWAN.

One specimen: Davidson (April 18).

A crippled bird was captured on Last Mountain Lake and brought back alive to Davidson, where it was placed with the other waterfowl on the pond of Mr. Reuben Lloyd. Mr. A. C. Lloyd reports that every year a considerable number of whistling swans pass through this district during migration. They alight not only on the larger lakes but also in small spring-filled sloughs, which later in the season dry up and are planted to oats. It may be that they find and feed upon grain left from the preceding year.

Branta canadensis moffitti Aldrich. BASIN CANADA GOOSE.

Two specimens: Last Mountain Lake.

These were shot on April 29, and were so identified by Dr. A. H. Miller (letter January 31, 1947) on the authority of the late James Moffitt. Dr. Sutton saw a single bird, presumably of this race, at Last Mountain Lake on May 24, and again on June 3, so there is a possibility that the species may breed.

Branta hutchinsii hutchinsii Richardson. HUTCHINS' GOOSE.

Eighteen specimens: Last Mountain Lake.

These were handled by the late James Moffitt, and they are referred to in his manuscript (*fide* Miller) as "good *hutchinsii*." Mr. Reuben Lloyd had several individuals of this species alive in his local aviary. So far as I could see they were precisely like the larger birds in carriage and deportment, but I did not have a chance to compare the voices of the two birds.

Anser albifrons gambelli Hartlaub. TULÉ GOOSE.

Twenty-five specimens: Last Mountain Lake.

In a paper presently to appear Dr. Arthur C. Twomey is giving reasons for referring these birds to *gambelli* rather than to *albifrons*. They were taken in migration between April 21 and May 13. A large proportion of them are immature, as is evidenced by the unspotted or lightly spotted underparts. Dr. Sutton reports seeing three belated migrants on Last Mountain Lake on May 28.

Mr. Lloyd says that during the spring migration Last Mountain Lake appears to be on one of the main flyways so far as geese (all kinds) are concerned; thousands pass over on their way north. But in the fall it is an entirely different story; the main flight appears to pass farther west.

Anas platyrhynchos platyrhynchos Linnaeus. MALLARD.

Five specimens: Davidson, Stalwart, and Last Mountain Lake.

A common and generally distributed summer resident, breeding in the sloughs and along the marshy shores of the lakes. Eggs were collected on May 21, June 1 and 11, and other nests were found which we did not disturb. The number of eggs varied from eight to eleven. The first young birds were noted on May 26. The males began flying by themselves about this time. On June 16 a male was seen in the beginning of the eclipse plumage. On June 18 fairly well developed young were seen.

Anas strepera Linnaeus. GADWALL.

Nine specimens: Davidson and Last Mountain Lake.

Fairly common as a summer resident. It was seen at intervals during our stay, both at Last Mountain Lake, Stalwart slough, and near Davidson. On June 20 and 21 several were seen on puddles and small ponds in the vicinity of Quill Lake and Raymore. On June 16 a set of eight eggs was collected at the slough east of Stalwart. The nest was of the usual down-lined type; it was placed beneath a broad clump of wild-rose bushes, about sixty feet back from the water's edge.

Anas acuta tzitzihua (Vieillot). AMERICAN PINTAIL.

Five specimens: Last Mountain Lake (October 12) and Davidson (near, September 18; and 12 miles west).

Next to the Mallard, the Pintail was the most common breeding duck in this region. Of the several nests found, only one was collected; this came from the head of Last Mountain Lake on June 14, and held seven eggs. The first downy young were noted on May 21, so that the egg date just quoted must have been a delayed or second nesting. A set of nine eggs was brought to Mr. Lloyd as early as May 1 (before our arrival). On June 10 a female and brood of young were seen near Elbow.

Anas carolinensis Gmelin. GREEN-WINGED TEAL.

Six specimens: Davidson (near; and 12-13 miles west).

The dates for these specimens are May 18, 20, June 29, and October 2 (in moult). There is only one definite breeding record: a downy young dated July 11. The Green-winged Teal is one of the rarer summer-resident ducks in this area.

Anas discors Linnaeus. BLUE-WINGED TEAL.

Five specimens: Last Mountain Lake, Stalwart, and Davidson.

One of the less common breeding ducks, but generally distributed—a

pair here and there. On June 3 I collected a set of nine fresh eggs from a nest on a low sandy point on Last Mountain Lake. It was a slight depression between two spreading herbaceous plants, and was lined with a few grassy fibers and down from the breast of the parent.

Mareca americana (Gmelin). BALDPATE.

Three specimens (downy young): Davidson (12 miles northeast, June 28; near, July 20 and August 2).

Rather common during the third week in May, at the time of our arrival; later it began to diminish in numbers. However, a female with a brood of small young was seen at Last Mountain Lake on June 18, and on June 28 a fairly well developed young bird was taken at Quinn's Lake.

Spatula clypeata (Linnaeus). SHOVELLER.

Eleven specimens: Stalwart, Last Mountain Lake, and Davidson (near; 13 miles west).

Common and generally distributed as a summer resident. Sets of eggs, varying from seven to ten in number, were taken from May 25 to June 23 inclusive at Last Mountain Lake. Downy young were first noted and collected on June 11, west of Davidson. On June 13 Dr. Sutton saw a male which was moulting into the eclipse plumage.

Aythya americana (Eyton). REDHEAD.

Six specimens: Davidson, Last Mountain Lake, and Stalwart.

This species was breeding in moderate numbers at the head of Last Mountain Lake, where there was a heavy growth of rushes. Two nests were found here in the dense growth: one on May 26 with nine eggs; the second on June 14 with fourteen. The second set was identified by collecting the female parent as she flushed. The latter nest was a large one, built up well above the water-level of the surrounding marsh, in the midst of the rushes; it was deeply hollowed out with broken rush-stems, and with the usual lining of down. The eggs of this set are uniform, but those of the first set are not. Five are precisely like those of the larger set; the other four are different, and look much like the eggs of the Canvasback. Ducks often lay in each other's nests, as is well known, but in such cases do they share in the duties of incubation and of rearing the young? On June 16 two downy young and two adult males were taken at Stalwart slough, and on June 28 two nests with eggs (nine and eleven) were found along the slough near Quinn's Lake.

***Aythya collaris* (Donovan). RING-NECKED DUCK.**

One specimen: near Simpson (October 6).

***Aythya valisineria* (Wilson). CANVASBACK.**

Three specimens: Last Mountain Lake and Devil's Lake.

Less common than the Redhead as a breeding species. It was plentiful at Quill Lake on June 20-21, and was noted repeatedly at the head of Last Mountain Lake in May and June. Here, on May 28, we found a nest, identified as belonging to this species, containing seventeen eggs; the next day there were twenty! Some of the eggs were actually outside the nest. It was a bulky nest, raised above the level instead of being in a depression. Obviously this must have been a cooperative enterprise for two or more females. We collected a set of nine eggs, one third or more incubated, on June 22 at Devil's Lake, together with the female parent. This must have been a delayed or second nesting, since we saw downy young at the Stalwart slough on June 16.

***Aythya affinis* (Eyton). LESSER SCAUP DUCK.**

Four specimens: Davidson.

Like the last a summer resident, not common. It was collected only near Davidson, but it was noted also at Last Mountain Lake and Devil's Lake. On June 28, west of Davidson, a female with a brood of young was found.

***Glaucionetta clangula americana*. AMERICAN GOLDEN-EYE.**

This species was seen only at Quill Lake on June 20, where three birds were seen by Dr. Sutton, and later a fairly large flock, and also a separate pair. These were probably non-breeding birds.

According to Mr. Lloyd, this species is somewhat more common in migration than Dr. Sutton's records would indicate.

***Glaucionetta albeola* (Linnaeus). BUFFLEHEAD.**

Dr. Sutton saw a few odd birds on Last Mountain Lake on May 25, June 1 and 2, and a flock on June 22. Almost certainly these were non-breeding birds.

***Melanitta fusca deglandi* (Bonaparte). WHITE-WINGED SCOTER.**

Three specimens: Last Mountain Lake.

Of fairly regular occurrence on Last Mountain Lake, where it was observed singly and in small flocks through May and June, and latterly in

apparently mated pairs. A female taken on June 1 showed some evidence of laying, but we found no nests certainly referable to this species, although Mr. Lloyd confidently asserts that it breeds on occasion.

***Oxyura jamaicensis rubida* (Wilson). RUDDY DUCK.**

Eight specimens: Davidson (near; and 13 miles west) and Last Mountain Lake.

An uncommon summer resident, noted at Last Mountain Lake, Devil's Lake, Davidson, and Quinn's Lake, at which last place a nest with five eggs was found in a slough on June 28. Adult males collected were in high breeding plumage, with the blue of the bill very brilliant. A female shot May 30 would probably have been laying eggs in about ten days.

***Lophodytes cucullatus* (Linnaeus). HOODED MERGANSER.**

Three specimens: Last Mountain Lake.

All were females in worn plumage at this date (July 11). Dr. Sutton reports seeing four birds at the same locality on May 23. The breeding status is uncertain.

***Mergus serrator* Linnaeus. RED-BREASTED MERGANSER.**

Dr. Sutton saw this species on Last Mountain Lake on three occasions only—May 24, May 25, and June 5. Nothing is known of its breeding here. Mr. Lloyd considers it fairly common in migration.

***Accipiter atricapillus* (Wilson). AMERICAN GOSHAWK.**

On June 25 Dr. Sutton saw one flying over at close range near Davidson.

***Accipiter striatus velox* (Wilson). SHARP-SHINNED HAWK.**

One specimen: Davidson (September 2). Mr. Lloyd has found it fairly common in migration.

***Buteo harlani* (Audubon). HARLAN'S HAWK.**

One specimen: Davidson (December 1).

An immature female, agreeing with a bird from Arkansas identified as *harlani* by Norman A. Wood. It has a barred tail.

***Buteo platypterus platypterus* (Vieillot). BROAD-WINGED HAWK.**

One specimen: Davidson (August 26).

None of the hawks listed thus far can be set down as breeding species. This and the preceding are rare.

Buteo swainsoni Bonaparte. SWAINSON'S HAWK.

Seventeen specimens: Davidson (near; 4 miles north; 6 miles north; 13 miles west; 14 miles west), Last Mountain Lake, and Elbow (3 miles west).

This series includes birds in a great variety of plumages; in fact, scarcely any two are alike. The species was common and generally distributed. Breeding pairs were nesting in the odd trees that grew here and there, but many non-breeding individuals were encountered. Telephone poles were favorite perches at all times. One shot on May 28 had the remains of a female pintail in its crop; a second bird had been feeding on ground-squirrels. We collected one set of three eggs on May 20, about thirteen miles west of Davidson; the nest was in a shrubby poplar, only ten feet from the ground, and was easily reached by standing on the top of our automobile. Near Elbow on June 9 an empty nest, apparently just ready for eggs, was found. On June 12, east of Davidson, we found a nest precariously perched in the top of a telephone pole by the roadside. It was removed because it was interfering with the telephone circuit.

Buteo regalis (Gray). FERRUGINOUS ROUGH-LEG.

Five specimens: Davidson (near; 13-14 miles west) and Last Mountain Lake.

This large hawk was fairly common (for a bird of prey), and its bulky nests were conspicuous objects in the trees, large and small, that stood out as landmarks over the plains. One nest that we examined was built in a group of such slender stems that it seemed to be in imminent danger of being blown down. We collected six sets of eggs, ranging in number from four to six (mostly five), between May 18 and 21, and found a nest with young near Elbow on June 8. One of these nests was in a shrubby willow, only three feet from the ground, and the highest was only twenty feet up. The eggs are handsomely spotted with shades of brown, in irregular pattern; they vary even in the same set. The screams of the birds as they protest intrusion are not unlike those of the Red-tailed Hawk. On June 11, some twelve miles west of Davidson, we found a very large female dead near her nest.

Circus cyaneus hudsonius (Linnaeus). MARSH HAWK.

One specimen: Imperial.

Fairly common, favoring the sloughs and marshes, where it breeds, building its nests in the drier parts. From the several nests we found, we collected only one set of eggs, five in number, on May 21, near Davidson.

Other nests were found at Stalwart slough, at the head of Last Mountain Lake, and at Devil's Lake. On June 7 a nest with seven eggs was found at the edge of a patch of "buck brush," twelve miles north of Davidson. As early as May 31 young were hatched.

Falco peregrinus anatum Bonaparte. DUCK HAWK.

Dr. Sutton saw a single individual each on May 27 and 28, at Last Mountain Lake, and a "large female" at Quill Lake on June 21.

Falco mexicanus Schlegel. PRAIRIE FALCON.

Thirteen specimens: Davidson (July 29–October 13).

A goodly proportion of these were immature birds. This fine series, secured by Mr. Lloyd at my special request, was taken during the post-breeding southward movement of this species that occurs every year. We saw a very few birds earlier in the season at Last Mountain Lake, between May 24 and June 3, but obtained no evidence of breeding.

Mr. Lloyd contributes the following interesting note: "During the fall of the year these pirates of the air were continually raiding the pigeons about the farm, yet I do not recall ever seeing one kill a pigeon. When the falcon appeared the pigeons would scatter and seek shelter anywhere they could. Any that were too late would tower until the danger was past. In the spring of the year the falcons did not bother the pigeons at all."

Falco columbarius richardsoni Ridgway. RICHARDSON'S PIGEON HAWK.

Two specimens: Devil's Lake (May 31) and Davidson (September 27).

In the Devil's Lake specimen the gonads were small, and it was probably a non-breeding bird. Its plumage was rather worn and faded.

Falco sparverius sparverius Linnaeus. EASTERN SPARROW HAWK.

One was noted by Dr. Sutton on June 22, not far from Devil's Lake. Mr. Lloyd reports seeing a few pairs every spring.

Tympanuchus cupido pinnatus (Brewster). GREATER PRAIRIE CHICKEN.

Five specimens: Last Mountain Lake.

Once a common species, but now greatly decreased in numbers. They were heard "booming" repeatedly at Last Mountain Lake, near Davidson, and at Stalwart. At Quill Lake, on June 20, we encountered a female with a brood of young. Two were seen at Devil's Lake on May 31.

Pedioecetes phasianellus campestris Ridgway. PRAIRIE SHARP-
TAILED GROUSE.

Six specimens: Davidson, Elbow, and Dafoe (15 miles south).

Generally distributed, although not common, at least in the breeding season. We found no nests, but on May 21 a female with bare brooding-patches was taken near Davidson, and on June 21 two downy young were collected from a brood found along the road, some fifteen miles south of Dafoe. The parent bird presented a sharply triangular crest in profile.

Grus americanus (Linnaeus). WHOOPING CRANE.

Mr. Reuben Lloyd had a fine mounted specimen of this species which was taken near Davidson some thirty years before. A few odd birds used to be seen every year in company with the next.

Grus canadensis (Linnaeus). LITTLE BROWN CRANE.

Fourteen specimens: Davidson (15 miles west; 10 miles east).

These were collected by Mr. Lloyd during flights which occurred on April 25 and May 5. They were exceedingly fat. Mr. Lloyd writes that the "crane grounds are some fifteen-eighteen miles west of Davidson, in an area which contains some untouched prairie, although the larger part of it is farm land. Here, in the spring of the year, there are numerous small alkali flats flooded with snow water. The cranes like to spend the nights in these shallow ponds—possibly because while there they feel safer from coyotes. Through the daylight hours they feed in the stubble fields, glean-ing grain, or occasionally in the prairie lands, catching insects. The procedure we followed in collecting specimens of this wild and wary bird might be of interest. After locating a flock on its feeding grounds we would try to outguess the birds and to forecast which way they would fly when disturbed. Two of the party would then drop off the moving car at different points and lie flat on the ground, while the driver would circle the cranes, approach from the other side, and try to drive them to fly over the hunters. This is not always so easy as it sounds, and more failures than successes are scored. One flock we saw we estimated as containing one thousand birds, and there must have been at least five thousand birds in the entire area. In the spring migration they pass overhead in long lines, or mill about perhaps in circles, but keep travelling in a general northwest direction. These flocks would contain from a few up to as many as a thousand individuals."

***Grus pratensis tabida* (Peters). SANDHILL CRANE.**

A rather rare and local summer resident. On June 20 we saw a party of five birds, shy and suspicious, along the south shore of Quill Lake, near Dafoe. Three were seen at Stalwart on June 16, and on June 28 we saw a pair and their young feeding near Quinn's Lake. On several occasions in previous years young birds were brought to Mr. Reuben Lloyd, but he never succeeded in raising them.

I continue to regard the Sandhill Crane and the Little Brown Crane as distinct species. The names will stand as above.

***Rallus limicola limicola* Vieillot. VIRGINIA RAIL.**

Our only record is of one seen in the cattails near Davidson on May 21.

***Porzana carolina* (Linnaeus). SORA RAIL.**

Two specimens: Davidson and Last Mountain Lake.

A common summer resident, and particularly numerous in the marshes at the head of Last Mountain Lake, where a set of nineteen eggs was collected from a nest first found on June 17, when it held only ten eggs. They were arranged in two tiers, and while some were fresh, others were far along in incubation. Probably two females laid in the same nest.

***Coturnicops noveboracensis noveboracensis* (Gmelin). YELLOW RAIL.**

One specimen: Last Mountain Lake.

This species was first noted in the marsh at the head of Last Mountain Lake on May 28. On June 13, at the same spot, Dr. Sutton got a momentary glimpse of the bird as it leaped above the grass. It kept to the thick marsh grass, and defied our combined efforts to put it up, although from its peculiar clicking notes its whereabouts were plain. There were times when it seemed to be almost underfoot, but so well did it keep concealed that we caught no sight of it. Returning the next day with a bird dog, Dr. Sutton and Mr. Lloyd were still unable to flush the bird, but the latter finally captured it alive by falling on it from above! The specimen constitutes the first known record for Saskatchewan. Individuals were again heard at the same spot on June 17 and 25.

***Fulica americana americana* Gmelin. AMERICAN COOT.**

A rather common summer resident, which finds ideal nesting conditions in all the larger sloughs and marshes of this region, and is often seen also in those of smaller size. On May 30 we found three nests, containing five, six, and seven eggs respectively, at the head of Last Mountain Lake. The next day (May 31), at Devil's Lake, we found two nests, one with

seven, the other with twelve eggs; the latter we collected. On a later visit (June 22) to the same spot, many nests were found, most of them with eggs hatching out. On June 28, about twelve miles southwest of Davidson, some young about two days old were discovered.

Charadrius melodus circumcinctus (Ridgway). BELTED PIPING PLOVER.

Nine specimens: Last Mountain Lake and Dafoe (4 miles east).

Two downy young from the latter locality are dated June 20. A set of four eggs was taken at Last Mountain Lake on June 2. This plover occurs on all the larger lakes where there are suitable dry beaches. It was common at Quill Lake on June 20, and as late as June 22 a set of four eggs and some downy young were taken at Last Mountain Lake by Mr. Fred G. Bard.

Charadrius semipalmatus Bonaparte. SEMIPALMATED PLOVER.

One specimen: Davidson.

I follow Ridgway in keeping this form specifically distinct from *C. hiaticula*. In the spring migration it was observed at Last Mountain Lake on May 23, 24, and 25 (a few only); in the fall migration the earliest record was for Davidson, July 20.

Charadrius vociferus vociferus Linnaeus. KILLDEER.

One specimen: Last Mountain Lake.

A summer resident, not uncommon; found in scattered pairs. Newly hatched young came from Davidson, May 26, and on June 26 a nest with four eggs was found near there. This was probably a second set for the season for a pair whose first nest had met with some mishap. On June 28 we saw young birds able to fly.

Pluvialis dominica dominica (Müller). AMERICAN GOLDEN PLOVER.

One specimen: Last Mountain Lake.

This species was a common transient from May 23 to June 3. The muddy shores of Last Mountain Lake and the fallow fields adjacent were favorite feeding grounds, but on May 26 we saw a flock of about fifty birds flying over at the Stalwart slough. The species was not nearly so numerous, however, as the Black-bellied Plover, with which it was often found.

Squatarola squatarola (Linnaeus). BLACK-BELLIED PLOVER.

Six specimens: Last Mountain Lake.

This plover was already common at Last Mountain Lake when we be-

gan work there on May 23, and so continued up to June 4. It appeared sometimes in good-sized flocks, feeding along the beaches as well as in the drier fields. The flocks were wild and suspicious of approach; when they alighted they did not go to feeding at once, but remained stationary with their heads well up, alert for danger. The smaller shorebirds usually followed their lead when they decamped. Three were seen at Quill Lake on June 20; these must have been non-breeding birds.

***Arenaria interpres morinella* (Linnaeus).** RUDDY TURNSTONE.

One specimen: Last Mountain Lake.

A fairly common transient, noted at Last Mountain Lake from May 22 to June 3. Usually it was in the company of other shorebirds, but on May 24 large flocks, consisting solely of this species, were observed, and on later occasions other smaller flocks. Three were seen here as late as June 22, and one at Quill Lake on June 20, but these must have been non-breeding individuals, as this species goes far north to nest.

***Numenius americanus occidentalis* Woodhouse.** NORTHERN CURLEW.

Seven specimens: Elbow.

A summer resident, once common, but becoming rare and local. We made a special trip to Elbow on June 8 to find this species. On the wide plains west of the Saskatchewan River we had hoped to find a colony established, but after a long search could discover but three individuals. These I located from hearing their calls a mile away, and we drove our car to the spot. The birds were very uneasy over our intrusion, and acted as if they had a nest close by. Dr. Sutton secreted himself as best he could on top of a knoll, while we drove out of sight. Returning after some time, we joined in the search over the suspected area, and presently I picked up a young bird in the down. It was squatting flat in the grass, and looked like a stone. The parents made a great outcry, and swept downward repeatedly. Two days later we secured one of the adults, and on July 22 Mr. Lloyd returned to this same area and collected a few adult and immature birds.

***Phaeopus hudsonicus* (Latham).** HUDSONIAN CURLEW.

Dr. Sutton reports seeing two birds of this species at Last Mountain Lake on May 27, and one on May 30. An uncommon transient.

***Bartramia longicauda* (Bechstein).** UPLAND PLOVER.

Nine specimens: Davidson (14 miles west), Last Mountain Lake, Elbow, and Imperial.

Locally distributed as a summer resident. This type of country is especially adapted to the needs of this species. On May 20 all birds seen were paired, and the females were already laying eggs. We saw about ten pairs that day, in dry fields and grasslands. No nests were discovered, but on June 26 we collected a downy young bird with its parent near Imperial. On June 21, near Raymore, Dr. Sutton saw a weasel chasing an old bird, which easily eluded capture simply by flight.

***Actitis macularia* (Linnaeus). SPOTTED SANDPIPER.**

An uncommon summer resident here. It was already present on May 19 at Davidson, where also a pair was noted on June 7. One was seen at Last Mountain Lake on May 27.

***Tringa solitaria solitaria* Wilson. EASTERN SOLITARY SANDPIPER.**

One specimen: Davidson (August 24).

One was seen on June 26 near Davidson, in company with a Lesser Yellow-legs.

***Catoptrophorus semipalmatus inornatus* (Brewster). WESTERN WILLET.**

Fourteen specimens: Last Mountain Lake and Davidson.

A very common summer resident, always found in the vicinity of water, and particularly numerous along the shores of Last Mountain Lake. Although it was thus common and vociferous, and obviously settled on its breeding grounds, we failed to find any nests. However, on May 27 a male was collected that must have been incubating eggs, and on June 4 a female was shot containing an egg almost ready to be laid. On June 14 broods of young were seen, and on June 18 one downy young bird was collected—both at Last Mountain Lake. Many were seen at Quill Lake on June 20.

***Totanus melanoleucus* (Gmelin). GREATER YELLOW-LEGS.**

We have two sight records. On June 23 Mr. Fred Bard identified one at the head of Last Mountain Lake. It was with a lesser yellow-legs and several willets. Again on June 28 one was satisfactorily identified by Dr. Sutton at Quinn's Lake. Probably these records were of non-breeding birds.

***Totanus flavipes* (Gmelin). LESSER YELLOW-LEGS.**

One specimen: Quinn's Lake.

The seasonal status of this species is uncertain. It was noted at intervals throughout our stay, and at several different places—Davidson, Last

Mountain Lake, Stalwart slough, Quill Lake, and near Nokomis. Single birds were the rule, but on June 26 about twenty were seen in a slough near Davidson. These could scarcely have been breeding birds under the circumstances, but the June records, taken as a whole, would suggest breeding. However, they did not behave like birds on their nesting grounds.

Calidris canutus rufus (Wilson). AMERICAN KNOT.

Two specimens: Last Mountain Lake.

These were taken on May 24-25, and were in full breeding dress. One of them was with a flock of black-bellied plover.

Erolia melanotos (Vieillot). PECTORAL SANDPIPER.

One specimen: Last Mountain Lake.

A transient visitant, noted first on May 14 (Lloyd). It was seen at intervals, in flocks and singly, up to June 4, usually in company with other shorebirds. A single bird was seen as late as June 22. It was very numerous at Stalwart on May 26.

Erolia fuscicollis (Vieillot). WHITE-RUMPED SANDPIPER.

Two specimens: Last Mountain Lake and Dafoe (4 miles east).

A fairly common transient, most numerous at Last Mountain Lake. It was first noted at Last Mountain Lake on May 16, and thence up to June 4. However, two were positively identified there on June 15, and three on June 23. Moreover, we saw several and collected one on Quill Lake, near Dafoe, on June 20. This individual was in apparently perfect plumage. All these must have been non-breeding birds.

Erolia bairdii (Coues). BAIRD'S SANDPIPER.

Ten specimens: Last Mountain Lake and Davidson.

A common transient visitant. Two specimens were collected at Davidson on May 12, and at Last Mountain Lake it was found up to June 4. A single non-breeding bird was seen here on June 22, and on June 20 one was shot at Quill Lake (but not preserved).

Erolia minutilla (Vieillot). LEAST SANDPIPER.

One specimen: Last Mountain Lake.

A transient visitant, but not common. Mr. Lloyd took a specimen on May 14, and Dr. Sutton saw and positively identified another on May 24, at Last Mountain Lake. Two were seen at Quill Lake on June 20, and one was collected to confirm the identification (but not saved).

***Limnodromus griseus griseus* (Gmelin). EASTERN DOWITCHER.**

Eleven specimens: Last Mountain Lake and Davidson.

Presumably these belong to the form described as *hendersoni*, which some authors consider the same as *griseus*, but which may be a valid race. It was seen and collected at intervals between May 12 and June 25, but it is not certainly known to breed. On June 14 a female with somewhat enlarged gonads and bare abdominal patches was taken along the lake shore. Seven in all were seen on June 22, three of which were collected.

***Micropalama himantopus* (Bonaparte). STILT SANDPIPER.**

Five specimens: Last Mountain Lake and Stalwart.

A transient visitant, first noted on May 23, common for two days only (May 26–27) at Stalwart slough, and last observed on June 2—except for a single bird in poor plumage taken on June 13. The big flight consisted of fair-sized flocks.

***Ereunetes pusillus* (Linnaeus). SEMIPALMATED SANDPIPER.**

Two specimens: Last Mountain Lake (June 22).

Like the Least Sandpiper, a transient visitant, but somewhat more common. It was recorded at Last Mountain Lake from May 22 to June 4, and was abundant on May 24. In addition, odd birds were positively identified at Stalwart on June 16, at Quill Lake on June 20, and at Last Mountain Lake on June 27. This sandpiper was usually found associated with other species of shorebirds, large and small.

***Tryngites subruficollis* (Vieillot). BUFF-BREASTED SANDPIPER.**

Twenty-five specimens: Last Mountain Lake.

A large flight took place on May 23–25, when the species appeared in flocks in the dry fields adjoining the lake. It passed through quickly, and none was seen after May 28. The call-note, as transliterated by Dr. Sutton, is "a short *chuh* or something of the sort." In life the general coloration, as compared with other sandpipers, is decidedly brownish, especially as seen from above. The bill is brownish black; the feet are dull yellow.

***Limosa fedoa* (Linnaeus). MARBLED GODWIT.**

Twenty specimens: Last Mountain Lake and Davidson (near; 12 miles north).

This fine species is one of the commonest and most characteristic species of shorebirds of this region. It was particularly numerous at Last Mountain Lake, whose shores were favorite feeding grounds, while the nesting

grounds were as a rule farther back, in drier areas. However, I found one nest on a sandy beach less than one hundred yards from the water's edge. On May 30 this nest held two eggs, and only one more was laid. On June 3 the set was collected, and on the same date Dr. Sutton collected a full set of four eggs. The nesting pairs were perfectly fearless, and would come a long distance to meet an intruder, flying around and uttering their shrill cries of alarm and protest. On June 12 we had a unique experience with a godwit that was incubating a single egg, and permitted itself to be lifted bodily from the nest, photographed, and replaced. The first downy young were noted on June 14, and at Quill Lake on June 21 many adults leading young were observed. One of the strange things in connection with this species was the number of individuals flocking together during the breeding season. For example, on June 4 one flock of thirty birds, separate from the mated pairs, was encountered at Last Mountain Lake. It was as if there was a considerable non-breeding population in evidence.

***Crocethia alba* (Pallas). SANDERLING.**

Two specimens: Last Mountain Lake.

A transient visitant, rather common at intervals, in flocks of its own kind and mixed with other shorebirds. Dates of observation range from May 25 to June 4, with one party of six seen on June 22. Most of the birds seen were in full breeding dress.

***Recurvirostra americana* Gmelin. AMERICAN AVOCET.**

Two specimens: Stalwart.

Rare as a summer resident. We collected a small downy young and the male parent at the Stalwart slough on June 16. The other parent and a second young bird were seen also but not taken.

***Steganopus tricolor* Vieillot. WILSON'S PHALAROPE.**

Twenty-two specimens: Last Mountain Lake, Stalwart, and Davidson (13-14 miles west).

A summer resident, common and generally distributed; it was encountered at virtually all the sloughs and bodies of water we visited. It was already common and in pairs when we arrived. The first nests were found on May 30, and the last (perhaps a delayed nesting) on June 28. There were four eggs in every case; they show the usual variation in density of markings. In every case the nests were found in the areas of low, marshy grasses back from the slough margins.

Lobipes lobatus (Linnaeus). NORTHERN PHALAROPE.

Four specimens: Last Mountain Lake and Davidson (13-14 miles west).

Fairly common as a transient. It was noted at Davidson on May 21, and on May 23 many were seen with other shorebirds at Last Mountain Lake. It was seen at intervals up to June 3, and on June 11 a flock was seen west of Davidson, and a pair was collected. At Stalwart slough a few were seen on May 26.

Larus californicus Lawrence. CALIFORNIA GULL.

One specimen: Last Mountain Lake.

A few were noted at Last Mountain Lake, May 26-June 2, and one specimen was collected. They were seen flying with the other gulls (ring-billed and Franklin's), among which they stood out because of their larger size. We found no signs of breeding.

Larus delawarensis Ord. RING-BILLED GULL.

Two specimens: Last Mountain Lake.

A common summer resident at Last Mountain Lake and Quill Lake. At the former place a colony of fifteen or more pairs was established on a long sandy point on the west shore of the lake. Two sets of eggs were collected here on May 25; both were partly incubated. On May 30, when I visited the spot, all the nests had eggs, varying in number from two to four. When I drew near all the birds rose into the air and kept circling about and raising a great commotion. On June 3 the first young bird had been hatched at this colony. On June 20, on the south shore of Quill Lake, we found a second colony, with nests containing two and three eggs, and some young birds able to walk and to swim. The birds make a great outcry when their nesting-grounds are invaded; indeed, there seem to be many more birds than the number of nests found would call for. Later in the day we found both this species and the Franklin Gull feeding in the fields, in scattered flocks; they seemed to be in search of grasshoppers. However, Dr. Sutton shot a bird on May 24 which apparently had been eating wheat.

Larus pipixcan Wagler. FRANKLIN'S GULL.

Twenty-one specimens: Last Mountain Lake.

Abundant on Last Mountain Lake, although it is not known to breed there. Mr. Lloyd took his first specimen on May 11, and it was excessively numerous there when we arrived on May 22. At daybreak the next morn-

ing I was aroused by the cries of scores of birds circling over the water and the shore. On May 30 the birds were excessively numerous, and again on June 4. Together with black terns, they were flying over the fields in swarms, alighting on the ground, and swirling around in all directions, feeding on "fish-flies." On June 13 a great cloud of Franklin gulls was seen over the lake; many of these were in subadult plumage. The last birds were seen on June 14. We did not succeed in locating their nesting-grounds. It may have been somewhere on Quill Lake, where they were common on June 20, although among them were many immature birds.

Of eight birds shot on May 12 whose digestive tracts were examined, one was empty; four contained kernels of wheat, and six contained a large number of beetles.

***Sterna hirundo hirundo* Linnaeus. COMMON TERN.**

Several were observed at Last Mountain Lake on May 23. Thereafter it was common, and on June 18 we visited a low gravelly island near the head of the lake where a colony of several dozen pairs was nesting. At our approach the birds rose in a great swarm, screaming their protest. Three eggs were the rule in their nests; two broods of young had already been hatched.

***Chlidonias nigra surinamensis* (Gmelin). BLACK TERN.**

Six specimens: Last Mountain Lake and Davidson (13 miles west).

A summer resident, locally common. One was noted at Davidson on May 20, and on May 25 at Last Mountain Lake it was excessively abundant, an estimated two thousand individuals having been seen. On May 27 we found a large flock gathered in close formation on a shoal in the lake, and approached in a boat to within twenty feet before they took wing. The same day we saw a great company milling around, high up over the land, apparently feeding on flying insects. On May 29 they were flying low, and we could see them catching "fish flies." We did not find them actually breeding, however, until June 29, when we visited a nesting colony about thirteen miles west of Davidson, in an isolated slough, and collected two sets of three eggs each, partially incubated. Several pairs were seen on June 21 about sloughs in the Raymore district.

***Zenaidura macroura marginella* (Woodhouse). WESTERN MOURNING DOVE.**

One specimen: Elbow (June 8).

Others were seen at Last Mountain Lake (May 22), Elbow (June 9,

five along gravel road), and the Touchwood Hills (June 21). It is evidently not common as a summer resident.

Bubo virginianus wapacuthu (Gmelin). ARCTIC HORNED OWL.

One specimen: Last Mountain Lake.

A female, collected April 26 by Mr. Lloyd, is referred to this northern race, with specimens of which it agrees well enough. I waive for the moment the question of the pertinence of the name. The date of capture seems late.

Nyctea scandiaca Linnaeus. SNOWY OWL.

One specimen: Davidson (November 23).

According to Mr. Lloyd, this Owl is a regular although not common winter visitant. Sharp-tailed grouse and prairie chickens appear to be its favorite prey at that season.

Speotyto cunicularia hypugaea (Bonaparte). WESTERN BURROWING OWL.

Two specimens: Davidson (12 miles southwest).

Now rare and local. We recorded it only twice, first on May 20, when we met with a pair about 14 miles west of Davidson, and again on June 28, as above. The country was dry and the grass was short where the burrow of this pair had been dug.

Asio otus wilsonianus (Lesson). LONG-EARED OWL.

One specimen: Last Mountain Lake (May 10).

This specimen is markedly paler and more lightly marked than most of our eastern birds, although closely approached by some. A series might show that a western race exists, but there is so much variation among the specimens studied in this connection that I doubt it.

One bird was seen on an island in Last Mountain Lake on May 27.

Asio flammeus flammeus (Pontoppidan). SHORT-EARED OWL.

We have a few scattered records for this Owl—from Stalwart slough, Elbow, Davidson (12 miles southwest), and Last Mountain Lake. Presumably it was breeding at all these places, but we found only one nest, this on the open prairie at the head of Last Mountain Lake on June 4. On this date it held six eggs, but when revisited on June 14 it was empty, and must have been robbed by crows or other predators.

Chordeiles minor sennetti Coues. SENNETT'S NIGHTHAWK.

Seven specimens: Imperial, Elbow, Devil's Lake, and Davidson (12 miles southwest).

Dr. Oberholser, in his review of the genus *Chordeiles* (Bull. U. S. Nat. Mus. No. 86, 1914, 52), does not allow *sennetti* to range north of the United States-Canadian boundary, but our Saskatchewan birds (June 16-28) seem clearly referable to this race; they agree well with Minnesota specimens so identified by Dr. Oberholser himself.

A summer resident, generally distributed but not common. Two nests were found near Imperial on June 15, with one egg in each.

Colaptes auratus × **cafer**. HYBRID FLICKER.

Two specimens: Elbow (June 9-10).

Other sight records obtained are from Davidson (May 20, nesting), Devil's Lake, Last Mountain Lake (June 5, nests in telegraph poles), and Touchwood Hills (June 21, two nests). On June 25 young were seen just leaving the nest at Davidson.

Melanerpes erythrocephalus caurinus Brodkorb. WESTERN RED-HEADED WOODPECKER.

One was seen near Davidson on June 5. It is referred to the western race on geographical grounds.

Tyrannus tyrannus (Linnaeus). EASTERN KINGBIRD.

Three specimens: Davidson (12 miles north), Quinn's Lake, and Elbow.

A summer resident, but not common except in the Elbow district, where we saw a considerable number on June 8 and 9. On May 28 we watched a pair building at Last Mountain Lake, and on June 7 we found two nests, one empty, the other with three eggs, the latter in a bush only five feet from the ground. This was twelve miles north of Davidson, on a brush-covered hillside dropping down to a lake. The nests were of the usual Kingbird type.

Tyrannus verticalis Say. ARKANSAS KINGBIRD.

One specimen: Davidson (August 20).

On June 7 we were shown the nest of a pair in a yard in the town of Davidson. Dr. Sutton supplies two records of birds seen at Last Mountain Lake on June 12 and 23.

Empidonax traillii traillii (Audubon). ALDER FLYCATCHER.

Four specimens: Davidson (near; 12 miles north) and Raymore.

A summer resident, not common, and locally distributed. Additional

to the above records, one was seen at Elbow on June 9, and one was heard calling at Devil's Lake on June 22. The identification of our specimens was made by Dr. Harry C. Oberholser.

Empidonax minimus (Baird and Baird). LEAST FLYCATCHER.

Six specimens: Davidson and Devil's Lake.

Like the last a summer resident, and not common; it is confined to brushy areas about the edges of bodies of water. On June 21 numbers were seen among the poplars, large and small, not far from Raymore.

Nuttallornis borealis (Swainson). OLIVE-SIDED FLYCATCHER.

One specimen: Elbow (June 10).

The seasonal status of this species here is uncertain.

Eremophila alpestris leucolaema (Coues). DESERT HORNED LARK.

Twenty-two specimens: Last Mountain Lake, Davidson (near; 14 miles west), and Elbow.

Through the courtesy of the late Prof. Myron H. Swenk I have been able to compare our Saskatchewan series with another from western Nebraska, comparable as to season. I can find no essential differences between the latter and the Saskatchewan birds, which are supposed to represent *enthymia* of Oberholser. The point is, however, that the type of *leucolaema* Coues came from Fort Randall, South Dakota, an intermediate locality. It was a March bird—one that would probably have gone farther north to nest. Almost certainly, therefore, *enthymia* is a synonym of *leucolaema*, although it has recently been recognized by the A. O. U. Committee and formally admitted to the Check-List (*cf.* Auk, 61, 1944, 452). If Colorado birds are different again (very doubtful) they would have to stand as *arenicola* Henshaw.

Males vary from pure white on the throat to decidedly yellow. Females, on the other hand, divide into two sets, in one of which the breast is more or less spotted and the upperparts are almost as dark as in *pratricula*. I do not understand the significance of this variation; it is not peculiar to this race.

"I am interested in your findings regarding the identity of our Nebraska breeding birds [Horned Larks] with those in southern Saskatchewan, which represent *Otocoris alpestris enthymia* Oberholser. I came to this conclusion, also, and have been referring our birds to *enthymia* on the supposition that it is distinct from the bird to which Oberholser restricted the name *Otocoris alpestris leucolaema* (Coues). This latter form we get in

winter in western Nebraska, and it is not easily distinguished from *enthymia*, but does run larger and a little paler perhaps. Our Horned Larks are going north in March, that is, the ones that do not breed here. Fort Randall, South Dakota, as you know, is just over the line from Boyd County, Nebraska, and I am sure that the birds migrating through that part of the state during early March are mostly if not all of the *enthymia* type. Probably an examination of Coues' type-specimen and the two others should be made to definitely settle the matter, since he refers to their large size, and of course *leucolaema* in the restricted sense does also occur in western and central Nebraska in winter, and it is possible that his birds were the larger form, if it is to be recognized as distinct."—Myron H. Swenk, letter February 18, 1933.

Very recently (May, 1947), at the United States National Museum, I compared the type-specimen of *E. leucolaema* Coues, together with one other male from Fort Randall, South Dakota, shot at the same time, with four of our Saskatchewan birds, and found them absolutely indistinguishable. Dr. Herbert Friedmann, who examined the specimens with me, agrees in this determination. The type of *enthymia* Oberholser we also handled; it is slightly different, but not enough so to deserve a name.

The Horned Lark was generally distributed throughout, in scattering pairs. Nests with eggs were found on May 20, 23, June 2, 3. Young of the first brood were noted on May 25. On June 18 Dr. Sutton saw the birds chasing ground squirrels. Mr. Lloyd says that the Horned Lark is the earliest spring arrival at Davidson; it comes invariably on February 20–22. Doubtless these are birds that breed farther north.

Iridoprocne bicolor (Vieillot). TREE SWALLOW.

Two specimens: Raymore and Imperial.

A summer-resident species, but confined to the vicinity of houses and tree-growth. The only positive breeding record pertains to a nest found a few miles north of Raymore on June 21. It was in an old woodpecker hole in a telephone pole.

Riparia riparia riparia (Linnaeus). BANK SWALLOW.

This swallow is a summer resident, but is local. It was noted at Last Mountain Lake and the Stalwart slough, and small nesting colonies were discovered at Imperial (in a railway cut), in the Touchwood Hills, and at Devil's Lake.

***Hirundo rustica erythrogaster* Boddaert. BARN SWALLOW.**

A few were noted at Davidson and Last Mountain Lake. At the latter place four birds kept trying to catch the moths inside the window netting. It was so cold that no insects were flying outside, so we amused ourselves by catching moths inside the house, tossing them out, and watching the swallows capture them. Mr. Lloyd says that there was always a pair or two breeding about the farm buildings at Davidson. He banded a pair there, and the female returned three successive years and the male two years.

***Progne subis subis* (Linnaeus). PURPLE MARTIN.**

One or two pairs were seen on June 20 near Jansen, west of Quill Lake, and the next day a nesting colony was noted in the town of Raymore.

***Pica pica hudsonia* (Sabine). AMERICAN MAGPIE.**

Two specimens: Davidson and Elbow.

This species is restricted to the isolated areas of bush and scrubby growth along the streams and some of the lakes; it is therefore local. At Devil's Lake we saw several old nests. A nest was found on the partially wooded plain west of the "elbow" of the Saskatchewan River. On June 8 it held five half-grown young, two of which we abstracted and raised by hand. They made interesting but mischievous pets. The parents were exceedingly wild.

***Corvus brachyrhynchos brachyrhynchos* Brehm. EASTERN CROW.**

Two specimens: Devil's Lake and Elbow.

I do not recognize a western race of this species.

For a region which is naturally treeless, except along the streams and lakes and where trees have been planted near houses for shelter or ornament, the crow is astonishingly numerous. Nests were located in shrubs only eight feet above the ground, in the crotches of telephone poles, and in trees close by houses. One nest on the premises of Mr. Reuben Lloyd was in a shade-tree poplar. For its original complement of eggs had been substituted the same number of those of the domestic fowl—to await hatching. This is a common practice here, it seems, and is frequently used in the case of hawks. One wonders what would happen in case the young chicks were not removed promptly.

On an island near the head of Last Mountain Lake we found a considerable number of crows on June 18. Their nests were everywhere on the trees covering the island. Undoubtedly such a concentration was a dis-

tinct menace to the ducks that were nesting in the immediate area, and we tried to help restore the proper balance by destroying as many as possible of the eggs, young, and adults. The nests (some of which were low down) held four, five, or six eggs.

***Parus atricapillus* subsp. BLACK-CAPPED CHICKADEE.**

A rather "ratty" breeding male bird was collected (but not preserved) in the Touchwood Hills, not far from Raymore, on June 21.

***Troglodytes aedon parkmanii* Audubon. WESTERN HOUSE WREN.**

One specimen: Davidson.

This bird was rare. It was recorded also at Last Mountain Lake, Devil's Lake (two pairs), and the Touchwood Hills, near Raymore (several).

***Telmatodytes palustris laingi* Harper. ALBERTA MARSH WREN.**

Eleven specimens: Stalwart and Last Mountain Lake.

This form is most nearly related to *T. p. iliacus*, but is still paler above and more purely white below (as compared with true *palustris*); the white streaking on the back is reduced, as it is in *iliacus* also. It is a good race.

Rather common at certain of the larger lakes and sloughs. It was especially numerous at the Stalwart slough, where eggs were collected on June 16, and at Devil's Lake, where more eggs were found on June 22. The nests and eggs were of the usual type for this species; six was the largest number of eggs found. Several birds were seen in the slough near Quinn's Lake on June 28, and an empty nest was found there.

***Cistothorus stellaris* (Naumann). SHORT-BILLED MARSH WREN.**

Five specimens: Last Mountain Lake and Davidson.

I differ sharply with the Check-List authorities, who would make this well differentiated form conspecific with the South American *C. platensis*. These specimens are precisely like eastern ones.

Rather rare, and found only at two localities. On June 17 two dummy nests were located, but none with eggs.

***Dumetella carolinensis ruficrissa* (?) Aldrich. WESTERN CATBIRD.**

As shown by material in the Carnegie Museum, this is a perfectly good race, well characterized by the paler color of the underparts. Unfortunately we have no Saskatchewan specimens, and our single record of a bird seen on June 7 twelve miles north of Davidson is referred to this new race solely on geographical probabilities.

Toxostoma rufum longicaudum (Baird). WESTERN BROWN THRASHER.

This species is an uncommon summer resident here. It was noted on a few occasions near Davidson, in the Elbow district, in the Touchwood Hills near Raymore, and at Devil's Lake. No specimens were taken, but the records are referred to the western race on geographical considerations.

Turdus migratorius migratorius (?) Linnaeus. EASTERN ROBIN.

An uncommon summer resident. A few odd birds were seen (but none collected) at Davidson, Last Mountain Lake, Devil's Lake, and in the Touchwood Hills. The subspecies is still uncertain.

Hylocichla ustulata swainsonii (Cabanis). OLIVE-BACKED THRUSH.

One specimen: Last Mountain Lake (May 24).

This specimen clearly belongs to the eastern race. Other individuals of this species were seen and heard at Davidson on June 5 and 7, in the shrubbery about Mr. Lloyd's home. On June 28 many were noted at Quinn's Lake. The date would suggest that they were breeding, but our observations leave the seasonal status uncertain.

Hylocichla fuscescens salicicola Ridgway. WILLOW THRUSH.

One specimen: Devil's Lake (June 22).

Several others were heard singing at this place on May 31 and June 22. One was noted on June 7 about ten miles northeast of Davidson.

Sialia currucoides (Bechstein). MOUNTAIN BLUEBIRD.

A female, probably with a nest, was seen near Dafoe on June 20 and 21.

Regulus satrapa satrapa Lichtenstein. EASTERN GOLDEN-CROWNED KINGLET.

One specimen: Last Mountain Lake (April 30).

Doubtless a transient.

Anthus spragueii (Audubon). SPRAGUE'S PIPIT.

Seventeen specimens: Last Mountain Lake and Davidson.

One of the characteristic breeding species of this region. It was common wherever there were any tracts of untouched prairie, such as that at the head of Last Mountain Lake. At almost any time of day one could hear them high overhead, flying around and singing almost out of sight from the ground, and hard to see against the glare of the sky, but they could only be secured by watching until they descended from these aerial excursions, then marking the spot carefully, and shooting them as they flushed. The song period may last as long as twenty minutes. We received

the impression that our invasion of the birds' territories was the signal to start singing. Several nests were found, the first on May 29. Five eggs are probably the usual number laid, but we found one nest with six. On June 7 and 8, near Elbow, we heard a few birds singing, and some were noted about four miles north of Davidson.

***Bombycilla garrula pallidiceps* Reichenow. BOHEMIAN WAXWING.**

One specimen: Davidson (December 3).

***Bombycilla cedrorum* Vieillot. CEDAR WAXWING.**

Six specimens: Elbow and Devil's Lake.

The dates of collection (June) would indicate breeding.

***Lanius ludovicianus excubitorides* Swainson. WHITE-RUMPED SHRIKE.**

Fifteen specimens: Davidson, Last Mountain Lake, Stalwart, and Raymore.

The amount of variation in the tail pattern shown by this series is certainly astonishing. In some examples the outer rectrices are wholly white, with the white area on the next pair correspondingly developed; in others there is a basal and a terminal band of white, separated from each other by a broad black area. Dr. A. H. Miller, in discussing this matter (Univ. California Publ. Zool., 38, 1931, 39), says that this feature is more variable than any other commensurable character. Several of our Saskatchewan birds show faint barring below; this is doubtless due to immaturity.

This species is of course only a summer resident, occurring in scattering pairs wherever there are suitable nesting grounds. Several nests were found, the first of which, collected at Davidson on May 30, already had six well incubated eggs. A second nest, found at the same place on June 11, had seven eggs almost ready to hatch. The species was noted also at Devil's Lake and near Elbow.

***Vireo solitarius solitarius* (Wilson). BLUE-HEADED VIREO.**

One specimen: Davidson (August 30).

***Vireo olivaceus* (Linnaeus). RED-EYED VIREO.**

Three specimens: Davidson (May 22; August 25).

This vireo is undoubtedly a summer resident, but it is local and far from common. We noted it at Devil's Lake on two occasions, and near Elbow.

Vireo gilvus gilvus (Vieillot). EASTERN WARBLING VIREO.

Five specimens: Devil's Lake and Raymore.

The impression persists that these represent a slightly differentiated and hitherto unrecognized race of the Warbling Vireo. Five males measure: wing, 71-76; tail, 52-57; exposed culmen, 11.5-12; tarsus, 17.5-18. Five males from Massachusetts and New Jersey, on the other hand: wing, 66.5-68.5; tail, 45-52; exposed culmen, 10-11; tarsus, 17-17.5. Not only do the Saskatchewan birds average larger, sex for sex, than these eastern specimens of *gilvus*, but also they are whiter below—more like *swainsonii*. Moreover, the white inner margins and tips to the rectrices are decidedly more prominent than in eastern *gilvus*. Three birds from Panajachel, Guatemala (Mus. Comp. Zool. 146,595-7), in their large size and in the whiteness of their underparts also resemble those from Saskatchewan. Measurements of the series of this species contained in the U. S. National Museum, recently made, confirm in general the above remarks, but the average difference in size is so little, and so many exceptions occur, that I hesitate to make any formal separation. However, I note that two specimens from Pembina, North Dakota (63890-1), possess the character of wide white tail margins, and it may very well be that additional material may reveal this as a constant and valid racial character.

This bird was common only at one place—in the poplar groves west of Raymore. It was once noted at Last Mountain Lake, in mimosa trees.

Vermivora peregrina (Wilson). TENNESSEE WARBLER.

One specimen: Last Mountain Lake (May 24).

A transient visitant, of which the above is our only record.

Vermivora celata celata (Say). ORANGE-CROWNED WARBLER.

One specimen: Davidson (May 21).

A transient only, going farther north to breed.

Vermivora celata orestera Oberholser. ROCKY MOUNTAIN ORANGE-CROWNED WARBLER.

Two specimens: Elbow (June 9).

This must be the breeding form of this region. Many other individuals were noted here on June 10.

Dendroica aestiva aestiva (Gmelin). EASTERN YELLOW WARBLER.

Seven specimens: Last Mountain Lake, Davidson, and Devil's Lake.

The Saskatchewan breeding birds are nearer to the eastern *aestiva* than to any other race, but the females show a tendency toward *amnicola*.

I am reluctant to reduce *Dendroica aestiva* to a subspecies of *D. petechia*, as proposed by Dr. John W. Aldrich, Auk, 59, 1942, 447-449. Because these two forms meet and breed together in one restricted area is no more reason for uniting them under one specific head than there would be in the case of *Icterus bullockii* and *I. galbula* (cf. Sutton, Auk, 55, 1938, 1-6).

The Yellow Warbler is fairly common wherever there is a growth of bushes and shrubbery. It was very numerous, for instance, on a wooded island near the head of Last Mountain Lake, as also in the poplar growth about Devil's Lake, and in the bushy country west of Elbow. No nests were actually found, but it certainly breeds throughout. The last one was taken on August 30.

There is a surprising variation in the songs of this species; some sang much like chestnut-sided warblers, others more like redstarts.

Dendroica magnolia (Wilson). MAGNOLIA WARBLER.

Two specimens: Davidson (May 21; August 30).

The dates are those of transient individuals. The May bird was taken in Mr. Lloyd's garden.

Dendroica coronata hooveri McGregor. ALASKA MYRTLE WARBLER.

One specimen: Last Mountain Lake (May 23).

A female, identified as above by Dr. A. C. Twomey.

Dendroica striata (Forster). BLACK-POLL WARBLER.

One specimen: Davidson.

A transient visitant, first noted at Davidson on May 19, and at Last Mountain Lake up to May 27.

Seiurus aurocapillus aurocapillus (Linnaeus). OVENBIRD.

One specimen: Davidson (May 21).

Seiurus noveboracensis notabilis Ridgway. GRINNELL'S WATER-THRUSH.

One specimen: Davidson (August 20).

This individual was doubtless an early fall migrant.

Geothlypis trichas occidentalis Brewster. WESTERN YELLOW-THROAT.

Four specimens: Davidson (14 miles west), Last Mountain Lake, Elbow, and Stalwart.

Breeding birds from Saskatchewan agree fairly well with those from Oregon. The first was taken on May 20, the last on June 28; the interval

covers the breeding season, although we found no nests. One was seen at Devil's Lake on May 31. The species was not common.

Wilsonia pusilla pusilla (Wilson). WILSON'S WARBLER.

One specimen: Davidson (August 30).

A transient species; the date probably represents a fall arrival.

Setophaga ruticilla (Linnaeus). AMERICAN REDSTART.

One specimen: Davidson (May 22).

This was taken in the tree-growth around Mr. Lloyd's house. What was probably the same individual was seen at the same place on May 20 and 21, but no others thereafter.

Dolichonyx oryzivorus (Linnaeus). BOBOLINK.

Seven specimens: Last Mountain Lake.

This species was common during June in the grassy country at the head of Last Mountain Lake. The first was seen on May 30. The first arrivals were all males; they were in full song. Some were seen at Quill Lake on June 20, and one near Quinn's Lake on June 28.

Sturnella neglecta Audubon. WESTERN MEADOWLARK.

Twelve specimens: Elbow, Last Mountain Lake, and Davidson.

A very common summer resident throughout. Its song, so unlike that of its eastern relative, reminded one somewhat of that of the Baltimore Oriole. Several nests were found, some with eggs as late as June 18, but these must have been delayed nestings, since we found a nestful of young on June 7, and on June 12 we saw young able to fly.

Xanthocephalus xanthocephalus (Bonaparte). YELLOW-HEADED BLACKBIRD.

Sixteen specimens: Last Mountain Lake, Stalwart, and Quinn's Lake.

Common as a summer resident but locally distributed. There was a good-sized colony at the Stalwart slough, and another at the head of Last Mountain Lake. Sets of eggs (four to a set) were taken on June 13 and 17. A juvenile male was collected near Quinn's Lake on June 28.

Agelaius phoeniceus arctolegus Oberholser. GIANT RED-WING.

Eighteen specimens: Last Mountain Lake and Davidson.

Eight males measure as followings: wing, 120-130 (average, 126.5); tail, 89-100 (95); exposed culmen, 23-27 (25.4); tarsus, 13-13.5 (13.1). Although all were taken in the breeding season, the females vary considerably in the intensity of the streaking on the underparts, and in the

amount of pinkish suffusion on the throat. Not having specimens of *A. p. fortis* in comparable plumage, I can express no opinion on the status and relationship of these two forms. Taverner (Canadian Field-Naturalist, 33, 1919, 13), however, discounts the validity of *arctolegus*.

This species was an abundant and generally distributed summer resident. Every slough and pond had its quota, and the larger marshes had a full population. The marshes at the head of Last Mountain Lake, and near Stalwart, were favorite breeding grounds. Nesting began the last of May, and the first eggs were found on May 29. Some nests were found in dead thistles, although the rule was to find them in the rushes or high marsh grasses. On June 11 a colony was located in a slough about thirteen miles west of Davidson. A nest was found at Raymore on June 21, and the birds were numerous near Dafoe and along the edge of Quill Lake on June 20. An albinistic male with a salmon-colored throat was collected about twelve miles southwest of Davidson on June 28.

Icterus galbula (Linnaeus). BALTIMORE ORIOLE.

Two specimens: Devil's Lake and Davidson.

A summer resident, but in a treeless country like this naturally not common. It was first noted at Davidson on May 20, and a few were seen around buildings at Last Mountain Lake. On May 29 a female was seen building a nest. On June 18 a pair of orioles at our headquarters attacked and tried to drive off the two young magpies we were raising. A specimen taken by Mr. Lloyd at Davidson on August 30 must have been near the end of its stay.

Euphagus cyanocephalus (Wagler). BREWER'S BLACKBIRD.

Five specimens: Raymore and Last Mountain Lake.

I find no difficulty in separating these birds from Pacific coast specimens (*minusculus* Grinnell) by the different sheen of their body plumage, but according to Grinnell and Miller (Pacific Coast Avifauna No. 27, 1944, 436, note) this feature is too inconstant to be used as a criterion for separation.

Brewer's Blackbird was a common species wherever there were any trees for nesting purposes. Several nests were examined about the Lloyd farmstead, and on May 22 two sets of five eggs were collected. One was in a poplar, six feet up, the other in a brushheap, only a foot from the ground. There was also a small colony in the trees around our cottage at Last Mountain Lake.

Quiscalus versicolor Vieillot. BRONZED GRACKLE.

A summer resident, locally distributed. About a dozen were seen at Davidson around the Lloyd farmstead, May 19–21. Here they were nesting in sheltered boxes. There were also some at Last Mountain Lake and at Stalwart slough. On May 26, at the latter place, we found nests that had been built in a barn; one had five eggs on this date. On June 18 grackles were viciously attacking our two tame magpies.

Molothrus ater artemisiae Grinnell. NEVADA COWBIRD.

Ten specimens: Last Mountain Lake, Stalwart, and Davidson (12 miles north).

Females of this series are paler on an average than eastern specimens of *ater*, although they are almost matched by some examples of the latter. The race is recognizable on this basis, but I would not consider it well marked. Males of the two respective forms are not certainly distinguishable, although those of *artemisiae* average larger.

A common summer resident, noted in the pasture lands, but not confined thereto. Eggs were found in nests of the Savannah Sparrow, Sprague's Pipit, and Red-winged Blackbird.

Hedymeles ludovicianus (Linnaeus). ROSE-BREASTED GROSBIRD.

One specimen: Davidson.

A male taken at Davidson on May 21 and a female seen at the same place on June 12 are our only records. Evidently this region is near the western limit of the species' range.

In my opinion, *Hedymeles* should not be merged with *Pheucticus*.

Acanthis hornemannii exilipes (Coues). HOARY REDPOLL.

Six specimens: Davidson (March 10, 16, 17, 1933).

A winter resident here, of erratic occurrence.

Acanthis flammea flammea (Linnaeus). COMMON REDPOLL.

Two specimens: Davidson (March 16, 1933).

Like the last, a winter resident, but erratic.

Spinus tristis tristis (Linnaeus). EASTERN GOLDFINCH.

Three specimens: Devil's Lake (June 22).

I am unable to distinguish these specimens (adult males) satisfactorily from eastern specimens. A few were seen at other places—Last Mountain Lake, Davidson (ten miles north), and Elbow.

Pipilo maculatus arcticus Swainson. ARCTIC TOWHEE.

Twelve specimens: Elbow.

Males vary in intensity of color of the upperparts; the blacker birds are probably those fully adult.

This species was first encountered in the brushy country along the west bank of the Saskatchewan River near Elbow, where it was not uncommon. A set of five eggs was taken here on June 9. A single bird was seen at Devil's Lake on June 22.

Calamospiza melanocorys Stejneger. LARK BUNTING.

One specimen: Davidson.

On June 5 Mr. Lloyd saw five birds together near Davidson—three adult males, one subadult male, and one female. On June 8 he succeeded in shooting a single individual near the same spot. One was seen on June 11 by the roadside about thirteen miles west of Davidson. These were the only times we saw this species; it is apparently quite rare.

Passerculus sandwichensis nevadensis Grinnell. NEVADA SAVANNA SPARROW.

Twenty specimens: Last Mountain Lake, Davidson (6 miles north), and Stalwart.

These are easily referable to the race described as *campestris* by P. A. Taverner, but which is placed as a synonym of *nevadensis* by Peters and Griscom (Bull. Mus. Comp. Zool., 80, 1938, 467). It is a common and generally distributed bird in this region; its wheezy song seems to be different from that of the eastern bird. As it happens, all our nesting records came from Last Mountain Lake and Stalwart slough. The first nest with eggs was found on May 24, and thereafter others up to June 18, when a set was collected. The number of eggs varied from three to five.

Ammodramus bairdii (Audubon). BAIRD'S SPARROW.

Twenty-three specimens: Last Mountain Lake and Davidson (6 miles north; 14 miles west).

The spotting on the breast varies a little in extent and intensity, but otherwise this series of breeding specimens is sufficiently uniform.

This is another characteristic bird of this region; however, it tends to be local in its distribution. It was common in the grass lands at the head of Last Mountain Lake, where the conditions were especially favorable—the same place as Sprague's Pipit favored. Dr. Sutton found a nest here on June 23; it held four eggs, which closely resemble those of the Grasshopper

Sparrow. Like the last-named species, Baird's Sparrow is a ground bird, but it often ascends a weed-top or the pole of a fence to sing. The first specimen was taken on May 20.

***Passerherbulus caudacutus* (Latham). LECONTE'S SPARROW.**

Two specimens: Davidson and Last Mountain Lake.

An apparently rare summer resident, taken by us on only two occasions (May 20, June 17).

***Ammospiza caudacuta nelsoni* (Allen). NELSON'S SPARROW.**

Twenty-two specimens: Davidson (12 miles west), Last Mountain Lake, and Stalwart.

These are breeding specimens, belonging to the pale interior race of Sharp-tailed Sparrow described from a fall migrant taken near Chicago, Illinois. Cf. Todd, Ann. Carnegie Mus., 29, 1942, 197-199, and Peters, *ibid.*, 201-210.

A fairly common bird at the head of Last Mountain Lake, haunting the high aquatic growth surrounding the sloughs and marshes. A few were noted elsewhere also. One June 13 its flight song was observed, and on June 23 a nest with young was found. The parents were feeding moths and other insects.

***Poocetes gramineus confinis* Baird. WESTERN VESPER SPARROW.**

Thirteen specimens: Last Mountain Lake, Davidson (near; 12 miles north; 14 miles west), and Elbow.

Common summer resident throughout. The first was noted on May 9. No nests were found.

***Spizella arborea arborea* (Wilson). EASTERN TREE SPARROW.**

One specimen: Davidson (March 16, 1933). It is very common as a transient, and is the first sparrow to arrive in the spring.

***Spizella passerina arizonae* Coues. WESTERN CHIPPING SPARROW.**

Two specimens: Davidson and Last Mountain Lake.

Apparently rare. We saw it at Last Mountain Lake on only two occasions, May 24 and 29, and Mr. Lloyd shot a juvenile bird near Davidson on August 20.

***Spizella pallida* (Swainson). CLAY-COLORED SPARROW.**

Seventeen specimens: Last Mountain Lake, Davidson (near; 6 miles north; 12 miles north), Raymore, and Elbow.

Common wherever there were tracts of bushes or "buck brush" to afford

shelter. The only nest we found was at Quill Lake on June 20, at which date it held small young.

Zonotrichia leucophrys gambelii (Nuttall). GAMBEL'S SPARROW.

One specimen: Last Mountain Lake (May 9). According to Mr. Lloyd, it is fairly common as a transient.

Zonotrichia albicollis (Gmelin). WHITE-THROATED SPARROW.

A transient visitant only; one was noted at Davidson on May 21. Mr. Lloyd calls it fairly common in migration.

Melospiza lincolni lincolni Audubon. LINCOLN'S SPARROW.

Three specimens: Last Mountain Lake and Davidson.

A transient visitant, fairly common. Dates of collection are from May 9 to 21.

Melospiza melodia juddi Bishop. DAKOTA SONG SPARROW.

Four specimens: Davidson, Last Mountain Lake, and Devil's Lake.

Not common; it favored brushy places, willow scrub, and similar covert. A bird in juvenal dress was taken at Davidson on June 25.

Rhynchophanes mccownii (Lawrence). MCCOWN'S LONGSPUR.

Twenty-one specimens: Davidson (4 miles north) and Last Mountain Lake.

Locally distributed as a summer resident. In a large field about four miles north of Davidson we found a colony of about twenty-five pairs, and secured a good series of specimens. (The field was about to be plowed, so we felt no qualms about taking as many as we needed from this one spot.) The males were indulging in their flight songs, at which times they presented an easy mark, but they were hard to approach on the ground. By dragging the field with a heavy rope we contrived to flush three incubating females from their nests, and to collect as many sets of five eggs each. The nests were very flimsy affairs, placed on the ground without any effort at concealment. The date was June 6. On a second visit to this spot on June 26 we saw a few birds, and on June 28 encountered a few also about twelve miles southwest of the town.

Calcarius lapponicus lapponicus (Linnaeus). LAPLAND LONGSPUR.

Seven specimens: Last Mountain Lake and Davidson (near; 12 miles west).

This species is merely a transient here, and it was still present in large

flocks on May 19 and 20 at Davidson. These flocks were rather shy, and were hard to approach on foot. Mr. Lloyd says that it sometimes appears in flocks of as many as a thousand birds. On May 25 one female was collected and several others were seen, but there were no males anywhere. This would seem to indicate that the males precede the females in the northward migration. However, a crippled male was shot on June 4.

Calcarius ornatus (Townsend). CHESTNUT-COLLARED LONGSPUR.

Twenty-one specimens: Last Mountain Lake and Davidson (near; 14 miles west).

A summer resident, common and generally distributed; first April 21. Eggs were taken on May 29 and June 14, but already, on May 30, we found a nest with newly hatched young.

As in *C. lapponicus*, the breeding dress of the male is acquired wholly by wear, through which the solid black of the pileum and the chestnut of the hindneck are effectively brought out. In a bird taken May 16 and another taken May 21 the black below is becoming exposed, while in birds shot during the next few weeks it becomes more "solid." It appears first as a crescent just below the pale throat, giving the bird an appearance like that of *Rhynchophanes mccownii*. Some individuals show more or less chestnut spotting on the underparts, even in winter dress; this is possibly a sign of excessive development. The only juvenile example in streaked plumage is one just out of the nest, dated June 14.

Plectrophenax nivalis nivalis (Linnaeus). EASTERN SNOW BUNTING.

Two specimens: Davidson (March 26, 1925).

One Snow Bunting was included in a large flock of Lapland Longspurs seen near Davidson on May 19. On several occasions during June and up to June 27, a male bird was seen here. It must have been a cripple, as the species occurs here only as a transient, sometimes in large flocks. It arrives early, but not before the Horned Lark.

07.73
PA 6842



INDEX

- absimilis, Staurocephalites?, 159
absis, Staurocephalites, 160
absolutus, Leodicites, 150
abyla, Adelphia, 281
Acanthis flammea flammea, 417
 hornemannii exilipes, 417
Accipiter atricapillus, 392
 striatus velox, 392
? accuratus, Paleoconites, 177
acheronta cadmus, Coea, 282
Achlyodes thraso, 291
acis, Eunicites, 183
acis gossei, Thecla, 286
Acris crepitans, 375
Actitis macularia, 399
aculeus, Eunicites, 183
acuminatus, Hesus, 40
acus, Eunicites, 182
acutus, Paleoconites, 170
adamsi, Eurema, 269
Adelphia abyla, 281
admirabilis, Staurocephalites, 158
aduncus, Staurocephalites, 157
adversus, Eonites, 165
aegon, Phyciodes pelops, 277
aestiva, Dendroica aestiva, 413
affinis, Aythya, 391
affinis, Boletus, 221
agarithe antillia, Phoebeis, 273
Ageronia februa antillana, 282
agostini, Leodicites, 149
agriodos, Staurocephalites, 161
alatus, Nereidavus, 189
alba, Crocethia, 402
albeola, Glaucionetta, 391
albicollis, Zonotrichia, 420
alboater, Boletus, 221
albolarvatus, Dryobates, 313
Allen, Glover M. A second specimen of
 an African Bat, Plerotes an-
 chietae (Seabra), 93-95
alutaceus, Boletus, 221
amaryllis paramaryllis, Pieris, 268
amazonum, Pyrrhura picta, 335
americana, Aythya, 390
 Fulica americana, 396
 Glaucionetta clangula, 391
 Mareca, 390
 Recurvirostra, 402
americanus, Boletus, 221
americanus, Grus, 395
Ammodramus bairdii, 418
Ammospiza caudacuta nelsoni, 419
ampliventris, Dysodius, 42
Amyda mutica, 85
amyntas, Polygonus, 289
Anaea johnsoni, 283
 troglodyta, 283
Anartia jatrophae jamaicensis, 279
anatum, Falco peregrinus, 394
anchietae, Plerotes, 93
angelia pantoni, Thecla, 285
angulosus, Nereidavus, 190
angulus, Leodicites, 154
angustifossus, Lumbriconereites, 137
angustisulcus, Leodicites, 151
ansatus, Eunicites, 185
Anser albifrons gambelli, 388
antaeus, Proteides, 288
antefixus, Leodicites, 146
antelius, Pionus sordidus, 338
Anteos lacordairei, 274
 maerula, 274
Anthurus borealis, 345
Anthus spragueii, 411
anticus, Leodicites, 149
antillana, Ageronia februa, 282
antillia, Phoebeis agarithe, 273
antiqua jamaicensis, Pyrrhocalles, 292
Aphleboderrhis comata, 41
 pilosa, 41
 pubescens, 41

- Appias drusilla jacksoni*, 268
appositus, *Staurocephalites*, 156
aptus, *Marphysaites*, 194
Arabellites (?) *clatonae*, 140
 (?) *doutti*, 140
rectidens, 140
Aradidae (Hemiptera), South American, 39-43
Aradus falleni, 39
mexicanus, 39
arborea, *Spizella arborea*, 419
arcas jamaicensis, *Ephyriades*, 290
arcticus, *Pipilo maculatus*, 418
arctolegus, *Agelaius phoeniceus*, 415
arcus, *Staurocephalites*, ? 157
Ardea herodias herodias, 387
arduus, *Marleneites*, 192
arizonae, *Spizella passerina*, 419
arquatus, *Leodicites*, 148
Artagerus crispatus, 41
hispidus, 40
histricus, 40
artatus, *Nereidavus*, 188
artemisiae, *Molothrus ater*, 417
artus, *Leodicites*, 145
asander, *Proteides*, 288
asander panthius, *Proteides*, 289
Asio flammeus flammeus, 405
otus wilsonianus, 405
asio, *Phrynosoma*, 89
assimilis, *Lumbriconereites*, 138
Astraeus hygrometricus, 354
Astraptus jaira, 289
roysi, 290
atalanta, *Vanessa*, 263, 278
atricapillus, *Accipiter*, 392
Parus, 410
atropurpureum, *Lycoperdon*, 348
aurantium, *Scleroderma*, 353
auratus X *cafer*, *Colaptes*, 406
aurea aurea, *Jacamerops*, 2
isidoro, *Jacamerops*, 3
penardi, *Jacamerops*, 3
ridgwayi, *Jacamerops*, 2
aureus, *Marleneites*, 193
auriflammeus, *Boletus*, 222
aurifrons incanescens, *Centurus*, 298
aurifrons, *Picumnus*, 316
aurifrons purusianus, *Picumnus*, 317
auriporus, *Boletus*, 222
auritus, *Colymbus*, 385
Phalacrocorax auritus, 386
aurocapillus, *Seiurus aurocapillus*, 414
australis, *Pyrrhura molinae*, 333
Avinoff, A. Affinities of *Phoebis rorata*
comstocki, a new Pierid butterfly from Jamaica, 45-56
Avinoff, A. and *Shoumatoff*, N., An annotated list of the Butterflies of Jamaica, 263-295, 1 map
avinoffi, *Gynaecia dirce*, 281
avinoffi, *Nereidavus*, 188
Aythya affinis, 391
americana, 390
collaris, 391
valisineria, 391
Bactrites? *collinsi*, 324
badius, *Boletus*, 222
bairdii, *Ammodramus*, 418
Erolia, 400
barbaricus, *Eunicites*, 179
Bartramia longicauda, 398
bazochii, *Thecla*, 286
Betula, *Boletus*, 222
bicolor, *Boletus*, 222
bicolor, *Iridoprocne*, 408
bicornis, *Lumbriconereites*, 134
bidwelli, *Aenonites*, 169
bifidus, *Orthopelta* ?, 196
biformis, *Leodicites*, 144
bifurcus, *Ungulites*, 187
bijugus, *Staurocephalites*, 159
bisulcus, *Leodicites*, 153
bittingsae, *Aenonites*, 167
Boletes (Fungi) of western Penna., A review of, by L. K. Henry, 213-240
Boletus affinis, 221
alboater, 221
alutaceus, 221
americanus, 221
auriflammeus, 222
auriporus, 222

- Boletus badius*, 222
 Betula, 222
 bicolor, 222
 castaneus, 223
 chromapes, 223
 chrysenteron, 223
 cyanescens, 224
 edulis, 224
 erythropus, 225
 eximius, 225
 felleus, 225
 Frostii, 226
 fumosipes, 226
 glabellus, 226
 gracilis, 226
 granulatus, 226
 griseus, 227
 hemichrysus, 227
 indecisus, 227
 luridus, 227
 luteus, 227
 miniato-olivaceus, 228
 modestus, 228
 niveus, 228
 nobilis, 228
 ornatipes, 228
 pallidus, 228
 parasiticus, 229
 Peckii, 229
 piperatus, 229
 plumbeoviolaceus, 229
 porphyrosporus, 229
 pulverulentus, 229
 retipes, 229
 rimosellus, 230
 rubeus, 230
 rubropunctus, 230
 russelli, 230
 scaber, 230
 separans, 230
 sordidus, 231
 subaureus, 231
 subglabripes, 231
 subluteus, 231
 subtomentosus, 231
 subvelutipes, 231
 vermiculosus, 232
 Boletus versipellis, 232
Boletinus castanellus, 220
 grisellus, 220
 paluster, 220
 pictus, 220
 porosus, 220
 spectabilis, 221
Bombycilla cedrorum, 412
 garrula pallidiceps, 412
borealis, Anthurus, 345
borealis, Dryobates, 313
borealis, Nuttallornis, 407
Botaurus lentiginosus, 387
Bothrops yucatanicus, 92
bourkei, Thecla, 285
Bovista minor, 346
 pila, 346
bovista, Scleroderma, 353
Bovistella radicata, 346
Brachygalba phaeonota, 10
brachyrhynchos, Corvus brachyrhyn-
 chos, 409
Brachyuranochampsia eversolei, 77
Branta canadensis moffitti, 388
 hutchinsii hutchinsii, 388
Brephidium isophthalma, 263, 287
breviculus, Leodicites, 151
brevipes, Dysodius, 42
brooksi, Leodicites, 144
Bubo virginianus wapacuthu, 405
Bufo perplexus, 89
buris, Leodicites, 152
Buteo harlani, 392
 playpterus platypterus, 392
 regalis, 393
 swainsoni, 393
Cabares potrillo, 291
cactophilus, Dryobates scalaris, 312
cadma, Lucinia, 281
cadmus, Coea acheronta, 282
caelata, Calvatia, 347
caeruleiceps, Pyrrhura subandina, 337
Calamospiza melanocorys, 418
calcaratus, Siluropelta, 196
Calcarius lapponicus lapponicus, 420
 ornatus, 421

- Calidris canutus rufus*, 300
californicus, *Colymbus nigricollis*, 385
californicus, *Larus*, 403
Calisto zangis, 283
Calostoma cinnabarina, 354
 lutescens, 355
 Ravenelii, 355
Calpodes ethlius, 294
Calvata caelata, 347
 craniiformis, 347
 cyathiformis, 346
 maxima, 347
 rubro-flava, 347
campestris, *Pedioecetes phasianellus*
 395
canadensis, *Grus*, 395
cardui, *Vanessa*, 278
carolina, *Porzana*, 396
carolinensis, *Anas*, 389
carolinensis, *Microhyla*, 241
carolinus zebra, *Centurus*, 298
cassius theonus, *Leptotes*, 286
castanellus, *Boletus*, 220
castaneus, *Boletus*, 223
castigatus, *Paleoenonites*, 171
Catia vesuria, 291
catillus, *Urbanus*, 288
Catoptrophorus semipalmatus inornatus, 399
caudacutus, *Passerherbulus*, 419
caurinus, *Melanerpes erythrocephalus*,
 406
cavus, *Eunicites*, 185
cecilii, *Veniliornis kirkii*, 311
cedrorum, *Bombycilla*, 412
celata, *Vermivora celata*, 413
Celeus innotatus degener, 305
 innotatus, 304
 lugubris, 305
celida shoumatoffi, *Thecla*, 284
Centurus aurifrons incanescens, 298
 carolinus zebra, 298
ceraunus, *Hemiargus hanno*, 287
Cerchneipicus tinnunculus occidentalis,
 306
Charadrius melodus circumcinctus, 397
 semipalmatus, 397
Charadrius vociferus vociferus, 397
charitonia simulator, *Heliconius*, 275
Chiomara gesta, 291
chiron, *Marpesia*, 280
Chlidonias nigra surinamensis, 404
Chlorippe laure fabricii, 282
Chlosyne pantoni, 277
chocoensis, *Veniliornis*, 309
Choranthus lilliae, 292
Chordeiles minor sennetti, 406
chromapes, *Boletus*, 223
chrysenteron, *Boletus*, 223
Chrysoptilus punctigula guttatus, 301
 rubidipectus, 303
 speciosus, 301
cinerea, *Hyla cinerea*, 364
cinnabarina, *Calostoma*, 354
circumcinctus, *Charadrius melodus*, 397
circumscripatus, *Paleoenonites*, 176
Circus cyaneus hudsonius, 393
Cistothorus stellaris, 410
clarkei, *Endoceras*, 24
clatonae, *Arabellites* (?) 140
claudia, *Euptoietia*, 263, 276
clementi, *Leodicites*, 152
cleophile, *Danais*, 263, 274
clinatus, *Paleoenonites*, 173
clypeata, *Spatula*, 390
Cnemidophorus deppii deppii, 90
Cniparchus haematogaster, 307
Coea acheronta cadmus, 282
Coelogasteroceras dubium, 320
coggeshalli, *Enonites*, 168
Colaenis julia delila, 276
collaris, *Aythya*, 391
collatus, *Leodicites*, 147
collinsi, *Bactrites*? 324
coloratum, *Lycoperdon*, 348
colossus, *Eunicites*, 182
columbianus, *Cygnus*, 388
columella cybira, *Thecla*, 285
Colus Shellenbergiae, 345
Colymbus auritus, 385
 grisegena holbollii, 384
 immer elasson, 384
 nigricollis californicus, 385
comata, *Aphlebederrhis*, 41

- compressus, Eunicites, 179
 comptus, Paleoenonites, 175
 comstocki, Phoebis rorata, 273
 concertatorius, Lumbriconereites, 127
 confertus, Ungulites, 187
 confinis, Poecetes gramineus, 419
 conjectus, Eunicites, 183
 Conophis vittatus vittatus, 91
 continuus, Leodicites ? 147
 convallis, Leodicites, 154
 copiosus ?, Lumbriconereites, 139
 corbis, Leodicites, 155
 cordatus, Hesus, 40
 coridon, Perichares, 295
 cornutum, Metaceras, 322
 Corvus brachyrhynchus brachyrhynchus, 409
 Coturnicops noveboracensis noveboracensis, 396
 craniiformis, Calvatia, 347
 crassus, Lumbriconereites, 129
 creditensis ?, Leodicites, 155
 crenulatus, Dysodius, 41
 crepitans, Acris, 375
 crethona, Thecla, 284
 crispatus, Artagerus, 41
 Crocethia alba, 402
 Crocomorphus flavus flavus, 306
 Crotalus lucasensis, 92
 mitchellii mitchellii, 92
 Crucibulum vulgare, 351
 cruentatus cruentatus, Tripsurus, 299
 cruentatus, Tripsurus cruentatus, 299
 Ctenosaura similis similis, 89
 cubana, Phoebis statira, 273
 cucullatus, Lophodytes, 392
 cuneiformis, Staurocephalites, 159
 currucoides, Sialia, 411
 Curtisii, Mutinus, 346
 curtum, Poteroceras, 319
 curvus, Lumbriconereites, 128
 cyanescens, Boletus, 224
 cyanocephalus, Euphagus, 416
 cyathiformis, Calvatia, 346
 Cyathus stercoreus, 352
 striatus, 352
 cybira, Thecla columella, 285
 Cygnus columbianus, 388
 Cymaenes silius, 294
 Cystineura dorcas, 278
 Danais cleophile, 263, 274
 eresimus, 275
 jamaicensis, 274
 plexippus, 274
 davisae, Paleoenonites, 175
 dea amazonum, Urogalba, 5
 brunneiceps, Urogalba, 6
 dea, Urogalba, 4
 phainopepla, Urogalba, 6
 decorahense, Endoceras, 27
 deflexus ?, Lumbriconereites, 139
 degener, Celeus innotatus, 305
 deglandi, Melanitta fusca, 391
 delawarensis, Larus, 403
 delila, Colaenis julia, 276
 Dendroica coronata hooveri, 414
 magnolia, 414
 striata, 414
 deppii deppii, Cnemidophorus, 90
 diaphanus, Hymenitis, 275
 Dictyophora duplicata, 345
 dillae, Paleoenonites, 170
 dina parvumbra, Eurema, 270
 Dione vanillae insularis, 275
 Diopatraites fustis ?, 197
 tricuspis, 197
 dirce avinoffi, Gynaecia, 281
 discors, Anas, 389
 dissimilis, Lumbriconereites, 136
 Dolichonyx oryzivorus, 415
 dominica, Hemiargus, 287
 Pluvialis dominica, 397
 dorcas, Cystineura, 278
 doutti, Arabellites ?, 140
 Drake, C. J. and Harris, H. M., South American Aradidae (Hemiptera) in the Carnegie Museum, 39-43
 drusilla jacksoni, Appias, 268
 Dryobates albolavatus, 313
 borealis, 313
 scalaris cactophilus, 312
 villosus hyloscopus, 312
 dubium, Coelogasteroceras, 320

- dubius, *Ænonites* ?, 166
Dumetella carolinensis ruficrissa (?), 410
duplicata, *Dictyophora*, 345
Dynamine zetes, 280
Dysodius ampliventris, 42
 brevipes, 42
 crenulatus, 41
 lunatus, 41

Echelatus simplicior, 290
edulis, *Boletus*, 224
elasson, *Gavia immer*, 384
elathea, *Eurema*, 271
eleuchea pellensis, *Marpesia*, 280
 Eller, E. R., *Scolecodonts* from the Trenton Series (Ordovician) of Ontario, Quebec, and New York, 119-212
Empidonax minimus, 407
 traillii traillii, 406
Endoceras clarkei, 24
 decorahense, 27
 gracillimum, 27
Eocathartes grallator, 58
Ephyriades arcas jamaicensis, 290
Epicrates exsul, 71
eresimus, *Danaus*, 275
Ereunetes pusillus, 401
Erolia bairdii, 400
 fuscicollis, 400
 melanotos, 400
 minutilla, 400
erythrogaster, *Hirundo rustica*, 409
erythropus, *Boletus*, 225
erythrorhynchos, *Pelecanus*, 386
ethlius, *Calpodes*, 294
eubotea, *Pieris monuste*, 268
eubule sennae, *Phoebeis*, 272
eufala, *Lerodea*, 294
Eunicites chiron, 280
 monima, 280
 tatila tatilista, 280
Eunicites acis, 183
 aculeus, 183
 acus, 182
 ansatus, 185

Eunicites barbaricus, 179
 cavus, 185
 colussus, 182
 compressus, 179
 conjectus, 183
 geisacanthus, 178
 kirkfieldensis, 181
 plackae, 184
Eunicites planoconvexus, 184
 sweadneri, 180
 toddi, 180
 tolmachoffi, 177
 twomeyi, 181
 whiteae, 178
Euphabus cyanocephalus, 416
Euptoietia claudia, 276
 hegesia, 276
Eurema adamsi, 269
 dina parvumbra, 270
 elathea, 271
 lisa euterpe, 271
 messalina, 269
 nicippe, 269
 palmyra, 270
 proterpia, 269
euterpe, *Eurema lisa*, 271
eversolei, *Brachyuranochampsia*, 77
excubitorides, *Lanius ludovicianus*, 412
exilipes, *Acanthis hornemannii*, 417
exilis, *Leodicites*, 148
eximium, *Lycoperdon*, 348
eximius, *Boletus*, 225
exsul, *Epicrates*, 71

fabricii, *Chlorippe laure*, 282
Falco columbarius richardsoni, 394
 mexicanus, 394
 peregrinus anatum, 394
 sparverius sparverius, 394
falleni, *Aradus*, 39
farrari, *Marleneites*, 193
februa antillana, *Ageronia*, 282
fedoa, *Limosa*, 401
felleus, *Boletus*, 225
femoralis, *Orthopelta* ?, 195
Ficimia olivacea streckeri, 91
fissilis, *Ænonites*, 166

- Fistulina hepatica*, 233
 pallida, 233
flammea, *Acanthis flammea*, 417
flammeus, *Asio flammeus*, 405
flavigula magnus, *Piculus*, 300
flavipes, *Totanus*, 399
flaviventris, *Hesus*, 40
flavus, *Crocomorphus flavus*, 306
frickei, *Paleoenonites*, 174
frisica, *Phyciodes*, 277
Frostii, *Boletus*, 226
fuehreri, *Ildraites*, 141
Fulica americana americana, 396
fumigatus, *Veniliornis*, 308
fumosipes, *Boletus*, 226
fuscicollis, *Erolia*, 400
fustus?, *Diopatraites*, 197
- Galbula tombacea mentalis*, 9
galbula, *Icterus*, 416
gambelli, *Anser albifrons*, 388
gambelii, *Zonotrichia leucophrys*, 420
Gasteromycetes, (Fungi) of w. Penna.,
 A review of, by LeRoy K. Henry,
 339-362
Gavia immer elasson, 384
Geaster mirabilis, 347
 saccatus, 347
 triplex, 348
 velutinus, 348
geisacanthus, *Eunicites*, 178
gemmatum, *Lycoperdon*, 349
genoveva, *Junonia*, 279
Geothlypis trichas occidentalis, 414
gesta, *Chiomara*, 291
gilvus, *Vireo gilvus*, 413
glabellus, *Boletus*, 226
Glaucionetta albeola, 391
 clangula americana, 391
Goin, *Coleman J.*, 71
gossei, *Thecla acis*, 286
gracilis, *Boletus*, 226
gracillimum, *Endoceras*, 27
Grais stigmaticus, 290
grallator, *Eocathartes*, 58
granulatus, *Boletus*, 226
granuliger, *Mezira*, 42
grisellus, *Boletinus*, 220
griseus, *Boletus*, 227
 Limnodromus griseus, 401
Grus americanus, 395
 canadensis, 395
 pratensis tabida, 396
gryllus, *Acris gryllus*, 377
guttatus, *Chrysoptilus punctigula*, 301
Gynaecia dirce avinoffi, 281
gypsatus, *Proxius*, 40
- Habitat bird groups, The birth of, by
 Frederic S. Webster, 97-118
haematogaster, *Cniparchus*, 307
handlirschi, *Mezira*, 42
hanno ceraunus, *Hemiargus*, 287
harlani, *Buteo*, 392
harteria, *Phoebis*, 273
Hedymeles ludovicianus, 417
hegesia, *Euptoieta*, 276
Heliconius charitonia simulator, 275
Hemiargus dominica, 287
 hanno ceraunus, 287
hemichrysus, *Boletus*, 227
 Henry, LeRoy K., A review of the
 Boletes (Fungi) of western Penn-
 sylvania 213-240
 Henry, LeRoy K., A review of the
 Gasteromycetes (Fungi) of west-
 ern Pennsylvania, 339-362
henryi, *Paleoenonites*, 172
hepatica, *Fistulina*, 233
heppenstallae, *Stauropthalites*, 163
herodias, *Ardea herodias*, 387
Hesus acuminatus, 40
 cordatus, 40
 flaviventris, 40
himantopus, *Micropalama*, 401
hirundo, *Sterna hirundo*, 404
Hirundo rustica erythrogaster, 409
hispidus, *Artagerus*, 40
Historis odius, 282
histricus, *Artagerus*, 40
hoactli, *Nycticorax nycticorax*, 387
holböllii, *Colymbus griseus*, 384
homerus, *Papilio*, 266
hooveri, *Dendroica coronata*, 414

- hudsonia, *Pica pica*, 409
 hudsonicus, *Phaeopus*, 398
 hudsonius, *Circus cyaneus*, 393
 hutchinsii, *Branta hutchinsii*, 388
 hygrometricus, *Astraeus*, 354
Hyla cinerea cinerea, 364
 squirella, 369
Hylephila phyleus, 292
Hylocichla fuscescens salicicola, 411
 ustulata swainsonii, 411
hyloscopus, *Dryobates villosus*, 312
Hymenitis diaphanus, 275
Hypanartia paullus, 278
Hypolimnas misippus, 282
hypugaea, *Speotyto cunicularia*, 405

Icterus galbula, 416
idas, *Proteides*, 288
Ildraites camurus, 142
 fuehreri, 142
 rarus, 143
impardentatus, *Ænonites*, 168
impudicus, *Ithyphallus*, 345
incanescens, *Centurus aurifrons*, 298
indecisus, *Boletus*, 227
innotatus, *Celex innotatus*, 304
inornatus, *Catoptrophorus semipalmatus*, 399
insolita, *Limochores*, 293
insularis, *Dione vanillae*, 275
interjecta, *Phyllotingis*, 39
intrinsecus, *Ænonites*?, 165
iole, *Nathalis*, 271
iole ab. albida, *Nathalis*, 272
Iridoprocne bicolor, 408
irregularis, *Lumbriconereites*, 131
isophthalma, *Brephidium*, 287
Ithyphallus impudicus, 345
 Ravenelii, 345

Jacamars and Puff-birds, 1
Jacamerops aurea aurea, 2
 isidoro, 3
 penardi, 3
 ridgwayi, 2
jacksoni, *Appias drusilla*, 268
jago, *Thecla simaethis*, 284

jaira, *Astraptes*, 289
jamaca, *Lerodea tripuncta*, 293
Jamaica, *Butterflies of*, by A. Avinoff,
 and N. Shoumatoff, 263-295,
 1 map
jamaicensis, *Anartia jatrophae*, 279
 Danaïs, 274
 Ephyriades arcas, 290
 Papilio polydamas, 267
 Pyrrhocalles antiqua, 292
jatrophae jamaicensis, *Anartia*, 279
jenningsi, *Lumbriconereites*, 131
johnsoni, *Anaea*, 283
johnsoni, *Lumbriconereites*, 132
julia delila, *Colaenis*, 276
Junonia genoveva, 279
 zonalis, 279

kayi, *Staurocephalites*, 156
kirkfieldensis, *Eunicites*, 181
kirkii cecilii, *Veniliornis*, 311
kosinskii, *Lumbriconereites*, 136
Kricogonia lyside, 272
 lyside ab. unicolor, 272
 terissa, 272
Kummel, *Bernhard*, 19-38

lacordairei, *Anteos*, 274
laingi, *Telmatodytes palustris*, 410
langae, *Lumbriconereites*, 130
Lanius ludovicianus excubitorides, 412
lapponicus, *Calcarius lapponicus*, 420
Larus californicus, 403
 delawarensis, 403
 pipixcan, 403
laure fabricii, *Chlorippe*, 282
lavinia, *Metamorphia stelenes*, 280
lentiginosus, *Botaurus*, 387
Leodicites absolutus, 150
 agostini, 149
 angulus, 154
 angustisulcus, 151
 antefixus, 146
 anticus, 149
 arquatus, 148
 artus, 145
 biformis, 144

- Leodicites bisulcus*, 153
 breviculus, 151
 brooksi, 144
Leodicites buris, 152
 clementi, 152
 collatatus, 147
 ? *continuus*, 147
 convallis, 154
 ? *creditensis*, 155
 corbis, 155
 exilis, 148
 semiquadratus, 146
Leptotes cassius theonus, 286
 perkinsae, 286
Lerodea eufala, 294
 tripuncta jamaca, 293
 sinepunctis, 293
leucolaema, *Eremophila alpestris*, 407
leucolaimus, *Piculus*, 301
Libythea terena, 283
lilliae, *Choranthus*, 292
limenia, *Thecla*, 285
limicola, *Rallus limicola*, 396
Limnodromus griseus griseus, 401
Limochores insolita, 293
Limosa fedoa, 401
lincolni, *Melospiza lincolni*, 420
linki, *Lumbriconereites*, 127
lisa euterpe, *Eurema*, 271
lobatus, *Lobipes*, 403
Lobipes lobatus, 403
Lobocara ovata, 42
longae, *Lumbriconereites*, 134
longicauda, *Bartramia*, 398
longidentatus, *Ungulites*, 186
longicaudum, *Toxostoma rufum*, 411
Lophodytes cucullatus, 392
lucasensis, *Crotalus*, 92
Lucinia cadma, 281
luciani, *Pyrrhura picta*, 336
ludovicianus, *Hedymeles*, 417
lugubris, *Celeus*, 305
Lumbriconereites angustifossus, 137
 assimilis, 138
 bicornis, 134
 concertatorius, 127
 ? *copiosus*, 139
Lumbriconereites crassus, 129
 curvus, 128
 ? *deflexus*, 139
 dissimilis, 136
 irregularis, 131
 jenningsi, 131
Lumbriconereites johnsoni, 132
 kosinskii, 136
 langae, 130
 linki, 127
 longae, 134
 macmillani, 132
 ? *okulitchi*, 138
 projectus, 129
 triquetrus, 133
 tuberosus, 135
lunatus, *Dysodius*, 41
luridus, *Boletus*, 227
lutescens, *Calostoma*, 355
luteus, *Boletus*, 227
lycoperdoides, *Scleroderma*, 352
Lycoperdon atropurpureum, 348
 coloratum, 348
 eximium, 348
 gemmatum, 349
 marginatum, 348
 pedicellatum, 350
 pulcherrimum, 350
 pusillum, 349
 pyriforme, 350
 rimulatum, 350
 subincarnatum, 351
 umbrinum, 351
lyside, *Kricogonia*, 272
lyside ab. unicolor, *Kricogonia*, 272

macconnelli, *Picumnus macconnelli*, 314
macmillani, *Lumbriconereites*, 132
macularia, *Actitis*, 399
maerula, *Anteos*, 274
magnolia, *Dendroica*, 414
magnus, *Piculus flavigula*, 300
Malacoptila panamensis magdalenae, 15
marcellinus, *Papilio*, 268
Mareca americana, 390
marginatum, *Lycoperdon*, 348
marginella, *Zenaidura macroura*, 404

- Marleneites arduus*, 192
 aureus, 193
 farrari, 193
 millerae, 192
Marpesia chiron, 280
 eleucha pellenis, 280
Marphysaites aptus, 194
martialis, *Thecla*, 285
Massey, T., 263
maxima, *Calvatia*, 347
mccallae, *Staurocephalites*, 164
mccownii, *Rhynchophanes*, 420
Megapicos pollens pollens, 307
Melanitta fusca deglandi, 391
melanocorys, *Calamospiza*, 418
melanoleucus, *Totanus*, 399
Melanosterphus spinosus, 42
melanotos, *Erolia*, 400
melonius, *Papilio thoas*, 267
Melospiza lincolni lincolni, 420
 melodia juddi, 420
Mergus serrator, 392
messalina, *Eurema*, 269
Metacoceras cornutum, 322
 perelegans, 322
Metamorphia stelenes lavinia, 280
mexicanus, *Aradus*, 39
mexicanus, *Falco*, 394
Mezira granuliger, 42
 handlirschi, 42
Microhyla carolinensis, 241, 363
Micropalama himantopus, 401
microtera, *Pyrrhura picta*, 335
Mierow, Dorothy, A distributional study of the Pine Siskin, 249-261
mierowae, *Staurocephalites*, 162
migratorius, *Turdus migratorius*, 411
Miller, A. K. and Kummel, Bernhard, Some large straight Ordovician Cephalopods from Minnesota, 19-38
 millerae, *Marleneites*, 192
 miniato-olivaceus, *Boletus*, 228
 minimus, *Empidonas*, 407
 minor, *Bovista*, 346
 minutilla, *Erolia*, 400
 mirabilis, *Geaster*, 347
 mississippi, *Hypolimnas*, 282
 mitchellii mitchellii, *Crotalus*, 92
 modestus, *Boletus*, 228
 modestus, *Veniliornis passerinus*, 311
 moftitti, *Branta canadensis*, 388
 molinae, *Pyrrhura molinae*, 331
 Molothrus ater artemisiae, 417
 monilifer, *Tainoceras*, 322
 monima, *Eunica*, 263, 280
 montei, *Notoplocoris*, 43
 monuste eubotea, *Pieris*, 268
 morinella, *Arenaria interpres*, 398
 mutica, *Amyda*, 85
 Mutinus Curtisi, 346
 Ravenelii, 345
 nataliae, *Sphyrapius thyroideus*, 313
 Nathalis iole, 271
 iole ab. albida, 272
 neglecta, *Sturnella*, 415
 nelsoni, *Ammospiza caudacuta*, 419
 Nereidavus alatus, 189
 angulosus, 190
 artatus, 188
 avinoffi, 188
 procurvus?, 191
Netting, M. Graham, The spineless soft-shelled Turtle, *Amyda mutica* (Le Sueur), in Pennsylvania, 85-88
Netting, M. Graham, and Goin, Coleman J., Another new Boa of the genus *Epicrates* from the Bahamas, 71-76
nettingi, *Staurocephalites*, 162
nevadensis, *Passerculus sandwichensis*, 418
nicippe, *Eurema*, 269
Nidularia pulvinata, 352
nivalis, *Plectrophenax nivalis*, 421
niveus, *Boletus*, 228
nobilis, *Boletus*, 228
notabilis, *Seiurus noveboracensis*, 414
Notoplocuris montei, 43
 potensis, 43
 noveboracensis, *Coturnicops noveboracensis*, 396

- Numenius americanus occidentalis, 398
 Nuttallornis borealis, 407
 Nyctea scandiaca, 405
 nyctelia, Panoquina, 295
 Nycticorax nycticorax hoactli, 387
 Nystactes tamatia inexpectatus, 14
 punctuliger, 14

 occidentalis, Aechmophorus, 385
 Cerchneipicus tinnunculus, 306
 Geothlypis trichas, 414
 Numenius americanus, 398
 ocola, Panoquina, 295
 odius, Historis, 282
 Oenonites adversus, 165
 bidwelli, 169
 bittingsae, 167
 coggeshalli, 168
 ? dubius, 166
 fissilis, 166
 heppenstallae, 163
 impardentatus, 168
 intrinsecus, 165
 mccallae, 164
 paquettensis, 164
 okulitchi, Lumbriconereites ?, 138
 olivacea streckeri, Ficimia, 91
 olivaceus, Vireo, 412
 oresteria, Vermivora celata, 413
 orinocensis, Pyrrhura picta, 334
 ornatipes, Boletus, 228
 ornatus, Calcarius, 421
 Orthopelta ? bifidus, 196
 ? femoralis, 195
 Orton, Grace L., Larval development of
 the eastern Narrow-mouthed
 Frog, Microhyla carolinensis
 (Holbrook), in Louisiana 241-
 248
 Orton, Grace L., Notes on some Hylid
 Tadpoles in Louisiana, 363-382,
 2 plates
 oryzivorus, Dolichonyx, 415
 ovata, Lobocara, 42
 Oxyura jamaicensis rubida, 392
 Paine, Miss Evelyn S., 263
 Paleoelonites ? accuratus, 177
 acutus, 170
 castigatus, 171
 circumscripatus, 176
 clinatus, 173
 comptus, 175
 davisae, 175
 dillae, 170
 frickei, 174
 henryi, 172
 pennatus, 173
 pallida, Fistulina, 233
 Spizella, 419
 pallidiceps, Bombycilla garrula, 412
 pallidus, Boletus, 228
 palmyra, Eurema, 270
 paluster, Boletinus, 220
 pan, Thecla, 284
 panamensis magdalenae, Malacopectil,
 15
 Panoquina nyctelia, 295
 ocola, 295
 sylvicola woodruffi, 294
 panthius, Proteides asander, 289
 pantoni, Chlosyne, 277
 Thecla angelia, 285
 Papilio homerus, 266
 marcellinus, 268
 pelaus, 266
 polydamas jamaicensis, 267
 thersites, 267
 thoas melonius, 267
 paquettensis, Staurocephalites, 164
 paramaryllis, Pieris amaryllis, 268
 parasiticus, Boletus, 229
 parkmanii, Troglodytes aedon, 410
 Parrots, New South American, W. E. C.
 Todd, 331-338
 Parus atricapillus, 410
 parvumbra, Eurema dina, 270
 Passerculus sandwichensis nevadensis,
 418
 Passerherbulus caudacutus, 419
 passerinus, Veniliornis, 310
 passerinus modestus, Veniliornis, 311
 passerinus saturatus, Veniliornis, 310
 paullus, Hypanartia, 278

- Peckii, Boletus, 229
 pedicellatum, Lycoperdon, 350
 Pedioecetes phasianellus campestris, 395
 pelaus, Papilio, 266
 Pelecanus erythrorhynchos, 386
 pellenis, Marpesia eleutheia, 280
 pelops, aegon, Phyciodes, 277
 pennatus, Paleoenonites, 173
 Pennoceras seamani, 325
 peregrina, Vermivora, 413
 perelegans, Metacoceras, 322
 Perichares coridon, 295
 Perkins, Miss Lilly, 263
 perkinsae, Leptotes, 286
 perkinsi, Proteides, 289
 perplexus, Bufo, 89
 phaeonota, Brachygalba, 10
 Phaeopus hudsonicus, 398
 Phoebeis agarithe antillia, 273
 eubule sennae, 272
 hartonia, 273
 rorata comstocki, 273
 statira cubana, 273
 Phoebeis rorata comstocki, Affinities of, 45-56
 Phyciodes aegon, 277
 frisiana, 277
 proclea, 277
 phyleus, Hylephila, 292
 Phyllogaster saccatus, 345
 Phrynosoma asio, 89
 Phyciodes frisiana, 277
 pelops aegon, 277
 proclea, 277
 phyleus, Hylephila, 292
 Phyllotingis interjecta, 39
 Pica pica hudsonia, 409
 picta, Pyrrhura picta, 334
 pictus, Boletinus, 220
 Piculus flavigula magnus, 300
 leucolaimus, 301
 xanthochlorus xanthochlorus, 299
 Picumnus aurifrons, 316
 aurifrons purusianus, 317
 macconnelli macconnelli, 314
 pusillus, 315
 Picumnus squamulatus squamulatus, 313
 transfasciatus, 317
 varzeae, 315
 Pieris amaryllis paramaryllis, 268
 monuste eubotea, 268
 pila, Bovista, 346
 pilosa, Aphleboderrhis, 41
 Pine Siskin, A distributional study of, by Dorothy Mierow, 249-261
 pinnatus, Tympanuchus cupido, 394
 Pionus sordidus antelius, 338
 piperatus, Boletus, 229
 Pipilo maculatus arcticus, 418
 pipixcan, Larus, 403
 plackae, Eunicites, 184
 planoconvexus, Eunicites, 184
 platyrhynchos, Anas platyrhynchos, 389
 platypterus, Buteo platypterus, 392
 Plectrophenax nivalis nivalis, 00
 Plerotes anchietae, 93
 plexippus, Danaus, 274
 plumbeoviolaceus, Boletus, 229
 pollens, Megapicos pollens, 307
 polydamas jamaicensis, Papilio, 267
 Polygonus amyntas, 289
 Poecetes gramineus confinis, 419
 porosus, Boletinus, 220
 porphyrosporus, Boletus, 229
 Porzana carolina, 396
 potensis, Notoplocoris, 43
 Poterioceras curtum, 319
 potrillo, Cabares, 291
 pratensis tabida, Grus, 00
 proclea, Phyciodes, 277
 procurvus, ? Nereidavus, 191
 Progne subis subis, 409
 projectus, Lumbriconereites, 129
 Proteides antaeus, 288
 asander, 288
 Proteides asander panthius, 289
 idas, 288
 perkinsi, 289
 proterpia, Eurema, 269
 proteus, Urbanus, 287
 Proxius gypsatus, 40
 pubescens, Aphleboderrhis, 41

- pulcher, *Tripsurus*, 299
 pulcherrimum, *Lycoperdon*, 350
 pulverulentus, *Boletus*, 229
 pulvinata, *Nidularia*, 352
 punctigula guttatus, *Chrysotilus*, 301
 punctigula rubidipectus, *Chrysotilus*, 303
 punctigula speciosus, *Chrysotilus*, 301
 purusianus, *Picumnus aurifrons*, 317
 pusilla, *Wilsonia pusilla*, 415
 pusillum, *Lycoperdon*, 349
 pusillus, *Ereunetes*, 401
 pusillus, *Picumnus*, 315
Pyrgus syrichtus, 291
 pyriforme, *Lycoperdon*, 350
Pyrrhocalles antiqua jamaicensis, 292
Pyrrhura molinae australis, 333
 molinae, 331
 restricta, 333
 sordida, 332
 picta amazonum, 335
 luciani, 336
 microtera, 335
 orinocensis, 334
 picta, 334
 subandina caeruleiceps, 337

Quiscalus veriscolor, 417

radicata, *Bovistella*, 346
Rallus limicola limicola, 396
rarus, *Ildraites*, 143
Ravenelii, *Calostoma*, 355
 Ithyphallus, 345
 Mutinus, 345
rectidens, *Arabellites*, 140
Recurvirostra americana, 402
regalis, *Buteo*, 393
Regulus satrapa satrapa, 411
restricta, *Pyrrhura molinae*, 00
retipes, *Boletus*, 229
Rhinthon thermae, 294
Rhynchophanes mccownii, 420
richardsoni, *Falco columbarius*, 394
rimosellus, *Boletus*, 230
rimulatum, *Lycoperdon*, 350
Riparia riparia riparia, 408

riparia, *Riparia riparia*, 408
rorata comstocki, *Phoebis*, 49, 273
 Roys, Chester, 263
 roysi, *Astraptes*, 290
 rubeus, *Boletus*, 230
 rubida, *Oxyura jamaicensis*, 392
 rubidipectus, *Chrysotilus punctigula*, 303
 rubro-flava, *Calvatia*, 347
 rubropunctus, *Boletus*, 230
 ruficrissa (?), *Dumetella carolinensis*, 410
 rufus, *Calidris canutus*, 300
 ruptifasciata, *Timochares*, 290
 russelli, *Boletus*, 230
 ruticilla, *Setophaga*, 415

saccatus, *Geaster*, 347
saccatus, *Phyllogaster*, 345
salicicola, *Hylocichla fuscescens*, 411
 Saskatchewan, Notes on the birds of southern, W. E. C. Todd, 383-421
satrapa, *Regulus satrapa*, 411
saturatus, *Veniliornis passerinus*, 310
scaber, *Boletus*, 230
scalaris cactophilus, *Dryobates*, 312
scandiaca, *Nyctea*, 405
Scleroderma aurantium, 353
 bovista, 353
 lycoperdoides, 352
 Scolecodonts from the Trenton Series, by E. R. Eller, 119-212
 seamani, *Pennoceras*, 325
Seiurus aurocapillus aurocapillus, 414
 noveboracensis notabilis, 414
semipalmatus, *Charadrius*, 397
semiquadratus, *Leodicites*, 146
sennae, *Phoebis eubule*, 272
sennetti, *Chordeiles minor*, 406
separans, *Boletus*, 230
serrator, *Mergus*, 392
Setophaga ruticilla, 415
Shellenbergiae, *Colus*, 345
 Shoumatoff, Nicholas with A. Avinoff, An annotated list of the Butterflies of Jamaica, 1 map, 263-295

- shoumatoffi, *Thecla celida*, 284
Sialia currucoides, 411
silius, *Cymaenes*, 294
Siluropelta calcaratus, 196
simaethis jago, *Thecla*, 284
similis similis, *Ctenosaura*, 89
simplicior, *Echelatus*, 290
simulator, *Heliconius charitonia*, 275
sinepunctis, *Lerodea tripuncta*, 293
 Smith, Hobart M. Additions to the list
 of Mexican Amphibians and
 Reptiles in the Carnegie Mu-
 seum, 89-92
smithi, *Stenopoceras*, 323
solitaria, *Tringa solitaria*, 399
solitarius, *Vireo solitarius*, 412
sordida, *Pyrrhura molinae*, 332
sordidus, *Boletus*, 231
Spatula clypeata, 390
speciosus, *Chrysoptilus punctigula*, 303
spectabilis, *Boletinus*, 221
Speotyto cunicularia hypugaea, 405
Sphaerobolus stellatus, 354
Sphyrapicus thyroideus nataliae, 313
spinosus, *Melanosterphus*, 42
Spinus tristis tristis, 417
Spizella arborea arborea, 419
 pallida, 419
 passerina arizonae, 419
spragueii, *Anthus*, 411
squamulatus, *Picumnus squamulatus*,
 313
Squatarola squatarola, 397
squatarola, *Squatarola*, 397
squirella, *Hyla*, 369
statira cubana, *Phoebe*, 273
Staurocephalites ? *absimilis*, 159
 absis, 160
 admirabilis, 158
 aduncus, 157
 agriodos, 161
 appositus, 156
 arcus, 157
 bijugus, 159
 cuneiformis, 159
 kayi, 156
Staurocephalites microwae, 162
Staurocephalites nettingi, 162
 ? *triplus*, 160
Steganopus tricolor, 402
stelenes lavinia, *Metamorpho*, 280
stellaris, *Cistothorus*, 410
stellatus, *Sphaerobolus*, 354
Stenopoceras smithi, 323
stercoreus, *Cyathus*, 352
stigmaticus, *Grais*, 290
strepera, *Anas*, 389
striata, *Dendroica*, 414
striatus, *Cyathus*, 352
strobilaceus, *Strobilomyces*, 232
Strobilomyces strobilaceus, 232
Sturnella neglecta, 415
subaureus, *Boletus*, 231
subglabripes, *Boletus*, 231
subincarnatum, *Lycoperdon*, 351
subis, *Progne subis*, 409
subluteus, *Boletus*, 231
subruficollis, *Tryngites*, 401
subtomentosus, *Boletus*, 231
subvelutipes, *Boletus*, 231
summerae, *Ungulites*, 186
surinamensis, *Chlidonias nigra*, 404
swainsoni, *Buteo*, 393
swainsonii, *Hylocichla ustulata*, 411
sweadneri, *Eunicites*, 180
syrichtus, *Pyrgus*, 291
sylvicola woodruffi, *Panoquina*, 294

 Tadpoles, hyliid, in Louisiana, by Grace
 L. Orton, 363-382, 2 plates
Tainoceras monilifer, 322
tamatia inexpectatus, *Nystactes*, 14
 punctuliger, *Nystactes*, 14
tatila tatilista, *Eunica*, 280
tatilista, *Eunica tatila*, 280
telea, *Thecla*, 284
Telmatodytes palustris laingi, 410
terena, *Libythea*, 283
terissa, *Kricogonia*, 272
Thecla acis gossei, 286
 angelia pantoni, 285
 bazochii, 286
 bourkei, 285
 celida shoumatoffi, 284

- Thecla columella cybira*, 285
 crethona, 284
 limenia, 285
 martialis, 285
 pan, 284
 pantoni, 285
 simaethis jago, 284
 telea, 284
theonus, *Leptotes cassius*, 286
thermae, *Rhinthon*, 294
thersites, *Papilio*, 267
thoas melonius, *Papilio*, 267
thraso, *Achlyodes*, 291
thyroideus nataliae, *Sphyrapicus*, 313
Timochares ruptifasciata, 290
tinnunculus occidentalis, *Cerchneipicus*, 306
Todd, W. E. C., *Studies in the Jacamars and Puff-birds*, 1-18
Todd, W. E. C., *Critical notes on the Woodpeckers*, 297-317
Todd, W. E. C., *New South American Parrots*, 331-338
Todd, W. E. C., *Notes on the birds of southern Saskatchewan*, 383-421
toddi, *Eunicites*, 180
tolmachoffi, *Eunicites*, 177
tombacea mentalis, *Galbula*, 9
Totanus flavipes, 399
 melanoleucus, 399
Toxostoma rufum longicaudum, 411
traillii, *Empidonax traillii*, 406
transfasciatus, *Picumnus*, 317
tricolor, *Steganopus*, 402
tricuspis, *Diopatraites*, 197
Tringa solitaria solitaria, 399
triplex, *Geaster*, 348
tripplus, *Staurocephalites*?, 160
Tripsurus cruentatus cruentatus, 299
 pulcher, 299
tripuncta jamaca, *Lerodea*, 293
tripuncta sinopunctis, *Lerodea*, 293
triquetrus, *Lumbriconereites*, 133
tristis, *Spinus tristis*, 417
troglydyta, *Anaea*, 283
Troglodytes aedon parkmanii, 410
Tryngites subruficollis, 401
 tuberosus, *Lumbriconereites*, 135
Turdus migratorius migratorius, 411
twomeyi, *Eunicites*, 181
Tympanuchus cupido pinnatus, 394
tyrannus, *Tyrannus*, 406
Tyrannus tyrannus, 406
 verticalis, 406
tzitzihua, *Anas acuta*, 389

umbrinum, *Lycoperdon*, 351
Ungulites bifurcus, 187
 confertus, 187
 longidentatus, 186
 sumnerae, 186
Urbanus catillus, 288
 proteus, 287
Urogalba dea amazonum, 5
 brunneiceps, 6
 dea, 4
 phainopepla, 6

valisineria, *Aythya*, 391
Vanessa atalanta, 278
 cardui, 278
 virginiensis, 278
vanillae insularis, *Dione*, 275
varzeae, *Picumnus*, 315
velox, *Accipiter striatus*, 392
velutinus, *Geaster*, 348
Veniliornis chocoensis, 309
 fumigatus, 308
 kirkii, *cecillii*, 311
 passerinus, 310
 passerinus modestus, 311
 passerinus saturatus, 310
vermiculosus, *Boletus*, 232
Vermivora celata celata, 413
 orestera, 413
 peregrina, 413
versicolor, *Quiscalus*, 417
versipellis, *Boletus*, 232
verticalis, *Tyrannus*, 406
vesuria, *Catia*, 291
villosus hyloscopus, *Dryobates*, 312
Vireo gilvus gilvus, 413
 olivaceus, 412
 solitarius solitarius, 412

- virginiensis, Vanessa, 278
vittatus vittatus, Conophis, 91
vociferus, Charadrius vociferus, 397
vulgare, Crucibulur, 351
wapacuthu, Bubo virginianus, 405
Webster, Frederic S., The birth of
 habitat bird groups, 97-118
Wetmore, Alexander, A new Terrestrial
 Vulture from the Upper Eocene
 deposits of Wyoming, 57-69
whiteae, Eunicites, 178
wilsonianus, Asio otus, 405
Wilsonia pusilla pusilla, 415
Woodpecker, Critical notes on, Todd,
 W. E. C., 297-317
woodruffi, Panoquina sylvicola, 294
Xanthocephalus xanthocephalus, 415
xanthocephalus, Xanthocephalus, 415
xanthochlorus, Piculus xanthochlorus,
 299
yucatanicus, Bothrops, 92
Zangerl, Rainer, Brachyuranochampsia
 eversolei, gen. et sp. nov., 77-84
zangis, Calisto, 283
zebra, Centurus carolinus, 298
Zenaidura macroura marginella, 404
zetes, Dynamine, 280
zonalis, Junonia, 279
Zonotrichia albicollis, 420
 leucophrys gambellii, 420

SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01724 3726